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REXOR ROTORCRAFT SIMULATION MODEL

Volume III - User's Manual

Lockheed California Co.
P.O. Box 551
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Final Technical Report

Approved for public release;
distribution unlimited.

Prepared for

U. S. Army Aviation Systems Command
P.O. Box 209
St. Louis, Mo. 63166

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EUSTIS DIRECTORATE POSITION STATEMENT

The REXOR analysis and computer program reported herein is considered to be a useful tool for the analysis of the dynamics, handling qualities, failure modes, performance, and loads of a single four-bladed, gyro-controlled, hingeless rotor helicopter. The REXOR capability to model two- or four-bladed teetering or articulated rotors is largely untried. The REXOR computer program may be used for the analysis of any of the above rotor types, while the analysis techniques should also be instructive in the development of other detailed analyses for helicopter rotors. The draft of this report was reviewed for technical content only.

The progress under this contract was monitored by a Technical Monitor Team consisting of Mr. A. W. Kerr, Headquarters, USAAMRDL; Dr. W. White, Langley Directorate, USAAMRDL; Mr. S. Hurt, Directorate for RD&E, AVSCOM; and Mr. H. I. MacDonald, Eustis Directorate, USAAMRDL. Mr. E. E. Austin, Eustis Directorate, provided additional technical review of the draft final report.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes a rotorcraft nonlinear simulation called REXOR, and is divided into three volumes. The first volume is a development of rotorcraft mechanics and aerodynamics. The second is a development and explanation of the computer code required to implement the equations of motion. The third volume is a user's manual, and contains a description of code input/output as well as operating instructions.

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The REXOR math model has been written for a single four-bladed, gyro-controlled, hingeless-rotor helicopter with additional capability for analysis of teeter or hinge-offset rotor systems with conventional controls and two or four blades. The helicopter modeled may be conventional in design, winged or compounded. Modeling emphasis is on an accurate main rotor description with additional degrees of freedom to describe the rest of the helicopter.

REXOR has been implemented on IBM 360 and CDC 6000 series equipment. The operating instructions are primarily based on the 360 equipment useage with additional instructions to show use on the 6000 series equipment.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF TABLES (Continued)

1. INTRODUCTION

1.1 CONTENTS OF MANUAL

Volume III is a user's manual. It is primarily concerned with the mechanics of operating the program. The user is assumed to be familiar with the contents of Volumes I and II. Many inputs are required and a large portion of these pages are devoted to a description of the inputs. Before discussing the inputs, the configurations the program can model and what constitutes easy and difficult program modifications are reviewed. The output plots and tabulations are also described. Due to the extensive computing time required for a run, a portion of this book is devoted to describing the run time requirements and time saving procedures. In the final section, the interfacing of the program in its uncompiled FORTRAN form with the user's machine is reviewed. Included are the series, sequential processing for time history plots, and Fast Fourier Transform analysis interface.

1.2 DEPTH OF PRESENTATION

Volume III assumes the user has a limited knowledge of the program and wishes to operate same. It is assumed that he is primarily an engineer and secondarily a programmer. How to modify the program is not a subject. The intention is to let the user input-output the program without a complete knowledge of the program code. This statement does not preclude the probable prospect that at least minor program changes will be wanted for a new configuration.

2. CONFIGURATIONS MODELED BY REXOR

2.1 MAJOR CONFIGURATION

The program, as presently structured, is limited to helicopter designs featuring a single main rotor and a tail rotor. However, there is nothing in the basic mathematical approach which limits the program to one lifting rotor.

2.2 OVERALL CONFIGURATIONS

Although the program is limited to one main rotor, the fuselage configuration is readily variable under one assumption; namely, the user is satisfied that the fuselage and its attachments can be treated as one rigid body with flexible rotor mast and controls and with rotors which are geared directly to the main rotor. Using inputs alone, a pure helicopter or a compound configuration with a pusher propeller can be simulated. The size of the horizontal and vertical tail surfaces can be readily changed. Note the programming is not highly versatile in that propellers, tail rotors, and fixed surfaces can be added only at limited locations and angles. The user, however, will find that programming changes for the aerodynamic and inertial characteristics of items attached to the fuselage are relatively easy under the assumption given above. If no additional degrees of freedom such as tail rotor shaft windup or fuselage bending are needed, then the programming changes can have a "tacked-on" structure.

2.3 MAIN ROTOR CONFIGURATIONS

The program can handle a hingeless or articulated rotor of four blades quite easily. The hingeless design can be either stiff or soft inplane, but no soft inplane design has been operated in the program at this writing. The program has been run however as a "soft" inplane articulated rotor. The only difference between a hingeless design with a "virtual" hinge and a blade with a real hinge is in the shape of the blade bending mode in the blade root area and in the spring matrix describing the elastic characteristics of the blade structure itself.

The program has interim modifications to handle the two blade teetering rotor. These changes allow for an independent, fully cantilevered inplane mode; a collective, fully cantilevered flap; and a teetering rigid body flap for which a hinged-flap, cantilevered-inplane constraint is appropriate.

The programming is presently restricted to four blades with the teetering exception above. Changes to allow for any number of blades would not be a troublesome modification, but would be extensive. A large number of variables allow a maximum of four in their dimension statements and would have to be changed.

2.4 CONTROL SYSTEM CONFIGURATIONS

Two basic configurations are modeled, the normal swashplate control configuration and direct-flap feedback control system featuring a small, isolated control gyro with a mechanical feedback proportional to cyclic hub flap deflections. The program also models the external gyro system the same as for a normal swashplate driven directly from the cyclic stick through actuators. The difference is in the input description where soft springs and a large swashplate inertia are characteristics of the gyro configuration. For the swashplate configuration, the inertia may be so low and the spring rates so high, that it may be appropriate to run the program with the swashplate degrees of freedom locked out. The characteristic frequencies of these modes can be quite high and may lead to computation or numerical instability for a reasonable azimuth step between time points.

3. PROGRAM INPUT

3.1 RELATIVE ADDRESS/MASTER DATA INPUT SYSTEM

3.1.1 Overview of Concept

REXOR provides for a comprehensive description of a rotocraft. Consequently, there are a large number of inputs. To provide a high degree of flexibility in manipulating the input data, the Relative Address (RA) input system is used. Some attributes of this form of data management are:

- the order of the data is immaterial
- the same item may be in the deck several times, the last one encountered being used.
- only that data which is necessary need be input.

A relative address system coupled with a master/temporary data set philosophy, produces an efficient data handling method.

The master data set idea provides a mechanism for good data management practices. For example, the master data sets could be stored on a storage device such as tape or disk and retrieved by name. The section which follows will present details concerning the construction and content of the data deck.

3.1.2 Data Deck Construction

Data deck construction concepts begin with a series of definitions. The total collection of data submitted to the computer at any one time is called a run deck. A run deck is composed of data cards and control cards. These two card types will be discussed presently. The collection of data cards is called a data unit. Three types of data units will be considered as the basic units of data deck construction. These are:

- master data
- permanent change data
- case data.

Master data is a data unit which will be the base for a series of cases. A data unit which will permanently change the master data unit currently in use is called a permanent change data unit. Values of data defined in this data unit will override corresponding RA's in the master data unit.

It should be added that permanency is only as long lived as the data deck in its current configuration. Case data is defined as a data unit which will temporarily override corresponding master data RA's. The resulting data will be executed as a case. The generalized data unit concept leave the user a great deal of freedom in data collection and management.

The data units within a data deck are identified to the program by control cards. Control card and data card format and definitions follow.

- CONTROL CARD FORMAT;

card columns 1 - 4 contain control characters.

5 - 8 must be left blank.

9 - 72 a comment field.

- CONTROL CHARACTER DEFINITIONS:

9999 "END OF RUN". This card is the last card of a run deck. It is always required.

8888 "MASTER DATA DECK HEADER" card. This card signals the beginning of a master data deck; i.e., all data cards which follow, up to the next "BLANK" control card, constitute a master data deck.

7777 "PERMANENT CHANGE DATA HEADER" card. This card signals the beginning of a permanent change data deck; i.e., all data cards which follow, up to the next "BLANK" card, constitute a permanent change data deck.

bbbb* "BLANK" card. This card signals the end of a data unit.

- DATA CARD FORMAT:

One to five inputs can be entered on an input card. The card format is as follows:

*b signifies a blank.

card column	field definition	quantity	
1 - 4	I4	IR1	right adjusted
5 - 8	I4	IR2	right adjusted
11 - 22	E12.0	V_1	
23 - 34	E12.0	V_2	
35 - 46	E12.0	V_3	
47 - 58	E12.0	V_4	
59 - 70	E12.0	V_5	

where IR1 is the RA of the first item on the card

IR2 is the RA of the last item on the card

If one and only one item is being inputted, V_1, then only IR1 is required.

> WARNING: THE INPUTS ON A GIVEN CARD ARE SEQUENTIAL, i.e., SKIPPING FIELDS, BY LEAVING BLANK, IS NOT ACCEPTABLE. BLANK FIELDS ARE INTERPRETED AS A ZERO VALUE.

Note the data field specification, E12.0. All inputs are real numbers and can be inputted in a variety of ways as described in your FORTRAN manual. But remember, an <u>absent decimal point</u> has an assumed position at the right of the field.

For tables of length greater than 5, i.e., more than will go on one data card, let

IR1 be address of first entry

IR2 be address of last entry of the table

Then skip the IR fields on subsequent cards.

Two RA's have been set aside to identify title information to the program, RA (1) and RA (16).

- TITLE CARD FORMAT:

COL 1 - 4	RA (1) or RA (16)
COL 11 - 70	TITLE INFORMATION

A run deck is composed of any number of data units with the following restrictions.

- The first data unit must be a master data deck.
- At least one case must be defined.

A case data unit may consist of no changes. However, the presence of a case must be indicated by a "BLANK" control card. The minimum run deck would look like that shown in Figure 3-1.

A typical data deck is given on Figure 3-2. Note that:

- A master data deck may be updated with any number of permanent change decks
- Change decks and case decks can be interspersed
- Any number of master decks may be present in a run deck. However, a master deck must be followed by at least one case deck.

Finally, an example of a data deck is presented in Figure 3-3.

3.1.3 Operational Advantages

The operation of the RA system permits categorizing data as either master data, master override data, or temporary case data. The system gives each input a unique address number. The advantage of master override is that a large block of data can be changed in the master due to a change of blade, the use of trim save cards, etc., for all the cases to follow. This block of data is easily identified and removed at the end of a series of cases. Hence the integrity of the master data is readily maintained.

The RA system also permits using the E format readin for data, flags, summation integers, etc. The internal equivalence within REXOR converts the numbers to the type actually needed. The inputs may even simultaneously be a flag and a physical constant.

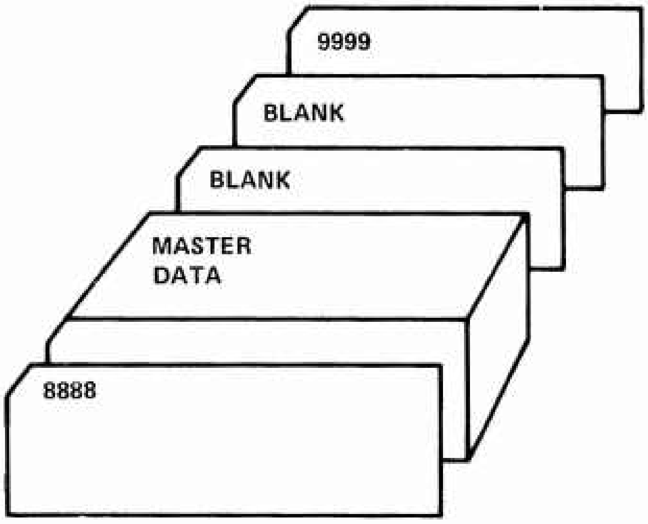


Figure 3-1. Minimum Configuration

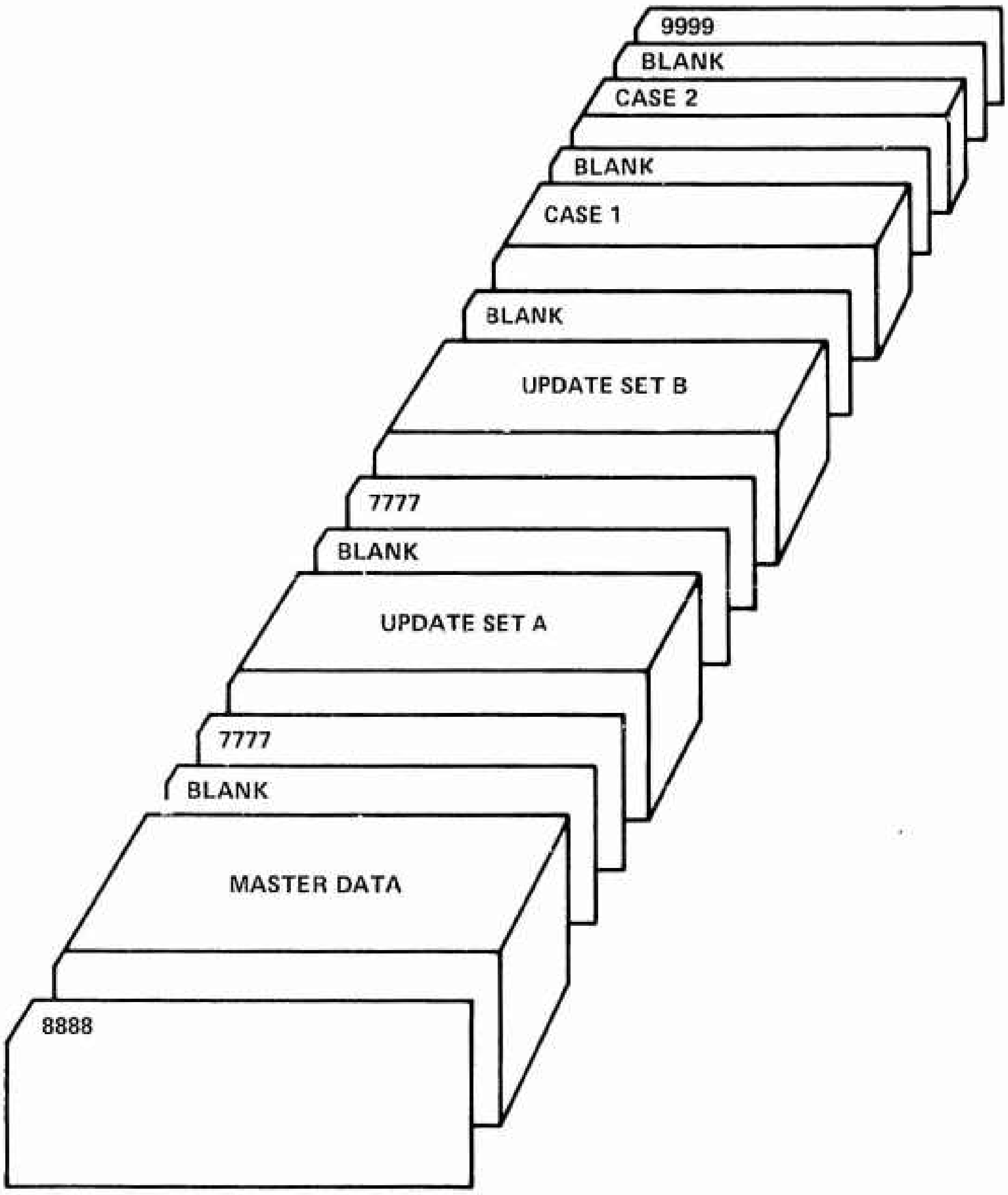


Figure 3-2. Typical Configuration

```
CARD COLUMNS

           1         2         3         4         5         6         7
123456789012345678901234567890123456789012345678901234567890123456789012


8888
   1        S - 58 VEHICLE DATA
  31        1000.
  32        180.
  36        24.
  45   48   1.             0.             1.             3.
 143  144   1.             -1.
 150        4.
 151  154   0.             1.             1.01           8.
 171  174   0.             0.             0.042          0.042
 274        -2.4
 267  289   1.             .05            .1
 301        1.0
 302  316    2.00000E 00 3.00000E 00 4.00000E 00 1.00000E 01 1.10000E 01
             1.20000E 01 5.00000E 00 8.00000E 00 9.00000E 00 6.00000E 00
             7.90000E 01 5.30000E 01 5.50000E 01 5.60000E 01 8.00000E 01
1474        1.0
 375  377   1.0            1.0            1.0
 298        1.0
                     END OF MASTER DATA
7777                THIS IS A BLADE DATA SET
   1        9-08-75 SIKORSKY H-34 BLADE  REXOR SIMULATION MODEL
  82   84      0.5494E 01  0.2385E 02  0.6229E 02
 501  505      0.1450E 01  0.2750E 01  0.5500E 01  0.7500E 01  0.9500E 01
 506  510      0.1200E 02  0.1375E 02  0.1575E 02  0.1875E 02  0.2150E 02
 511  513      0.2400E 02  0.2575E 02  0.2800E 02
 541  545      0.1744E 01  0.2928E 00  0.1009E 00  0.1622E 00  0.1644E 00
 546  550      0.1596E 00  0.1689E 00  0.1784E 00  0.1540E 00  0.1578E 00
 551  553      0.1856E 00  0.1537E 00  0.2670E 00
 761  765      0.0         0.6400E-01  0.1648E 00  0.2383E 00  0.3120E 00
 766  770      0.4044E 00  0.4692E 00  0.5435E 00  0.6550E 00  0.7575E 00
 771  773      0.8507E 00  0.9160E 00  0.1000E 01
                    END OF BLADE DATA SET
  50        5801.
 372        .6
 297        21.0
1498        0.0
  36        4.0
                     END OF CASE   DATA
9999
```

Figure 3-3. Data Deck Card Image Example

3.2 THE RA SET (COMPLETE NUMERICAL LIST)

The listing which follows (Table 3-1) is designed primarily as a memory aid for the experienced user. Only a brief description of each input is given. The user is advised to consult Section 3.3, which categorizes the inputs into logical groups and supplies comprehensive information as to each input's use.

The following table includes:

- the relative address (RA)
- the equivalenced FORTRAN name
- a brief description
- units, if applicable
- typical values.

For the sake of completeness, addresses which are not currently used are indicated as OPEN. Program variable dimension information is included where applicable. A row of ***** indicates the input is used by the program directly as a RA constant without being equivalenced to a FORTRAN name. Parenthesis after the FORTRAN name encloses the diminsions of that name.

A reverse directory, Table 3-2, is given to aid in finding the RA number when the FORTRAN name is known.

3.3 PROGRAM OPERATION VIA INPUT

The following is a narrative guide to the inputs listed in Section 3.2. The input data are discussed in logical groups which bring out the interrelationship of the various inputs as well as giving details as to the nature of each input.

Before proceeding some words of caution are given. The program has been used primarily for analyzing helicopters employing Lockheed's rigid rotor concept with a control gyro featuring flap bending feedback. Limited application of the program has been made to a four-bladed articulated and a two-bladed teetering rotor. The adapting of the program to other configurations may generate a complete new set of inputs. Program modifications may be required, and a debugging process expected. The logic is complex and new logic paths may be opened with unsatisfactory results. Numerics may be a problem. In other words, the program should not be expected to be polished and readily adaptable to a variety of configurations.

TABLE 3-1. INPUT DATA/RELATIVE ADDRESS TABLE

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1	(15)	TITLE CARD 1	S-58	
2			DATA	
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16	(15)	TITLE CARD 2		
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31	XCSMAX	MAX. LONG. STICK TRAVEL	1.0000E 03	FT
32	AZT	NO. OF COMPUTATION POINTS/REV DURING TRIM	1.8000E 02	
33	TRIMC (3)	ROTOR ROLL MOMENT (TRIM) +RT	0.0	FT-LB
34		ROTOR PITCH MOMENT (TRIM)+N.UP	0.0	FT-LB
35		ROTOR SHAFT LIFT (TRIM) +UP	0.0	LB
36	TCUT	MAX REVOLUTIONS TO TRIM	4.0000E 00	
37	OPEN		0.0	
38	BET	SIDESLIP ANGLE +RT	0.0	RAD
39	OPEN (3)		0.0	
40			0.0	
41			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION		SAMPLE VALUE	UNITS
42	HARDSP	HARD SWASHPLATE OPTION IF =1, NO SP D.O.F.		1.0000E 00	
43	OPEN			0.0	
44	NSDATA	BLADE SECTION AERO FLAG 0=TABLE,1=LINEAR		0.0	
45	CRSFG	CONSTANT ROTOR SPEED FLAG 1=CONST. ROTOR SPEED		1.0000E 00	
46	ICONTR	MASS MATRIX PRINT FLAG. 0=OFF, 1=ON. 1ST PT. TRIM AND FLY		0.0	
47	IPUNCH	PUNCH A TRIM RESTART DATA DECK 0=OFF 1=ON		1.0000E 00	
48	IPLOT	PLOT FLAG,0=NONE,1=TRIM,2=FLY, 3=BOTH,4=SPECIAL FLY PLOT		3.0000E 00	
49	IPRINT	PRINT EVERY COMP. POINT FOR 1ST REV OF TRIM. 0=OFF 1=ON		0.0	
50	CASE	CASE NO.		5.8020E 03	
51	NAZ	NO. OF POINTS/REV. IN FLY		2.4000E 02	
52	O	MAIN ROTOR SPEED		2.3210E 01	RAD/SEC
53	BP	PROPELLER BLADE ANGLE,	+THRUST	0.0	RAD
54	A1S	LATERAL CYCLIC	+N.DN	7.8301E-02	RAD
55	B1S	LONGITUDINAL CYCLIC	+N.DN	6.1318E-02	RAD
56	THO	COLLECTIVE	+THRUST	2.3560E-01	RAD
57	THOTR	TAIL ROTOR COLLECTIVE	+THRUST	9.1368E-02	RAD
58	ALPHA	ANGLE OF ATTACK	+N.UP	-5.0684E-02	RAD
59	PHI	BANK ANGLE	+RT	-1.4815E-01	RAD
60	SNGBLF	SINGLE BLADE FLY OPTION 0=OFF, 1=ON		0.0	
61	GINT	GYRO EQ. SUB-INTEGRATION INTERVAL MULT. FACTOR		0.0	
62	VT	TRAJECTORY VELOCITY		1.2300E 02	FT/SEC

TABLE 3-1 Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION		SAMPLE VALUE	UNITS
63	GAMMA	FLIGHT PATH ANGLE	+CLIMB	0.0	RAD
64	OPEN			0.0	
65	WIMR	VERTICAL DOWNWASH	+DN	9.4481E 00	FT/SEC
66	PIMR	ROLL DOWNWASH	+RT	-7.4834E-03	RAD/SEC
67	QIMR	PITCH DOWNWASH	+N.UP	-6.2103E-03	RAD/SEC
68	OPEN			0.0	
69	GLCON	SWP ROLL CONTROL MOMENT	+RT	0.0	FT-LB
70	GMCON	SWP PITCH CONTROL MOMENT	N.UP	0.0	FT-LB
71	WIMRD	D/DT OF WIMR		0.0	
72	PIMRD	D/DT OF PIMR		0.0	
73	QIMRD	D/DT OF QIMR		0.0	
74	WIMRN1	BACKVALUE OF WIMR		0.0	
75	PIMRN1	BACKVALUE OF PIMR		0.0	
76	QIMRN1	BACKVALUE OF QIMR		0.0	
77	A1TR	TAIL ROTOR LONG. FLAP ANGLE		3.8492E-02	RAD
78	WITR	TAIL ROTOR DOWNWASH	+LT	1.5680E 01	FT/SEC
79	OPEN			0.0	
80	TAU	TRIM CONTROL TIME CONSTANT		1.0000E-02	SEC
81	R	MAIN ROTOR RADIUS		2.8000E 01	FT
82	OB (3)	BLADE BENDING NAT. FREQ. USED IN HARMONIC TRIM		5.4940E 00	RAD/SEC
83				2.3850E 01	RAD/SEC
84				6.2290E 01	RAD/SEC
85	TH1	TOTAL BLADE TWIST +N.UP AT TIP		-1.3960E-01	RAD
86	OPEN (4)			0.0	
87				0.0	
88				0.0	
89				0.0	

TABLE 3-1 -- Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
90	IPITCH	STICK DESENSITIZER AND PITCH ROLL DECOUPLER.0=OFF,1=ON	0.0	
91	FMASS	FUSELAGE MASS	3.4000E 02	SLUG
92	ENDMZZ	ENGINE TRIM TORQUE	0.0	FT-LB
93	H,-ZF	HEIGHT ABOVE GROUND	1.0000E 03	FT
94	OPEN (2)		0.0	
95			0.0	
96	HF	DISTANCE FROM FUSELAGE AXIS TO HUB +UP	8.0000E 00	FT
97	STR	TAIL FIN-ROTOR BLOCKAGE FACTOR	8.5000E-01	
98	SLTR	DISTANCE FROM FUSELAGE AXIS TO TAIL ROTOR +AFT	3.3000E 01	FT
99	OPEN (2)		0.0	
100			0.0	
101	SLHS	DISTANCE FROM FUSELAGE AXIS TO HORISONTAL TAIL +AFT	2.8000E 01	FT
102	SLVS	DISTANCE FROM FUSELAGE AXIS TO VERTICAL TAIL +AFT	3.0000E 01	FT
103	HVS	DISTANCE FROM FUSFLAGE AXIS TO VERTICAL TAIL +UP	2.0000E 00	FT
104	EDIT	NEW DATA DECK OPTION 0=OFF,.NE.0=ON	0.0	
105	OPEN		0.0	
106	ETAE	EQUIVALENT VELOCITY RATIO AT TAIL	9.0000E-01	
107	OPEN (2)		0.0	
108			0.0	
109	RHO	AIR DENSITY	2.0500E-03	SLUG/FT3
110	CORD	MAIN ROTOR BLADE CORD	1.3670E 00	FT
111	SMALLA	LINEAR AERO COEFF. DCL/DALPHA	0.0	1/RAD
112	DELTO	LINEAR AERO COEFF. CDO	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
113	DELT2	LINEAR AERO COEFF. DCL/DALPHA2	0.0	1/RAD2
114	FCF	FEATHER FRICTION	0.0	FT-LB
115	RLF	FEATHER STICTION BREAK POINT	0.0	RAD/SEC
116	FCG	SWASHPLATE FRICTION	0.0	LB
117	RLG	SWASHPLATE STICTION BREAK POINT	0.0	RAD/SEC
118	IZZG	SWASHPLATE POLAR MOMENT OF INERTIA	5.0000E 00	SLUG-FT2
119	CHI	CONTROL TO SWP PHASE ANGLE (+) SWP LEADS CONTROL	-5.8200E-01	RAD
120	OPEN (3)		0.0	
121			0.0	
122			0.0	
123	QKXCS	SPRING CONSTANT,LONG. STICK OR GEAR RATIO	3.5900E-01	FT-LB/FT
124	QKYCS	SPRING CONSTANT,LAT. STICK OR GEAR RATIO	2.3900E-01	FT-LB/FT
125	BETAG	PITCH HORN LEAD AZIMUTH (+) P.H. FWD OF BLADE	5.8200E-01	RAD
126	OPEN (2)		0.0	
127			0.0	
128	HUBL (5)	INBOARD BEARING STATION	1.5470E 00	FT
129		DIST. BETWEEN FEATH. BEARINGS	5.4170E-01	FT
130		NOT USED	0.0	
131		NOT USED	0.0	
132		NOT USED	0.0	
133	NGORF	GROUND RUN OR FREE FLY FLAG 0=FREE FLY,1=FIXED SHAFT	0.0	
134	CYCFLG	FLY PLOT SCALE FLAG,RA(298) 0=SEC/IN,1=CYCLES/IN	0.0	
135	DEODA	DE/D(ALPHA) AT TAIL FROM WING	0.0	
136	E	PITCH HORN LENGTH	1.0000E 00	FT
137	QKGZ1	SWP VERTICAL SPRING RATE	0.0	LB/FT

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
138	QCGZ	SWP VERTICAL DAMPING COEFF	0.0	LB/FT/S
139	GMASS	SWP MASS	0.0	SLUG
140	QKGZ2	SWP VERTICAL LIMITER SPRING RATE	0.0	LB/FT
141	ZG1	SWP VERTICAL SPRING BREAKPOINT	0.0	FT
142	CORAF	TRIM OPTION INDICATOR	4.0000E 00	
143	TURNLF	TURN LOAD FACTOR	1.0000E 00	G
144	TURNSN	FLAG FOR TURN LEFT OR RIGHT +=RIGHT	-1.0000E 00	
145	C1I1	INPLANE TO FEATHER COUPLING	0.0	
146	C1F1	FIRST FLAP TO FEATHER COUPLING	0.0	
147	OPEN		0.0	
148	C2F1	SECOND FLAP TO FEATHER COUPLNG	0.0	
149	OPEN		0.0	
150	NMP	NO. OF POINTS IN PILOT CONTROL TABLES	4.0000E 00	
151	PT (20)	PILOT TIME TABLE	0.0	SEC
152			1.0000E 00	SEC
153			1.0100E 00	SEC
154			8.0000E 00	SEC
155			0.0	SEC
156			0.0	SEC
157			0.0	SEC
158			0.0	SEC
159			0.0	SEC
160			0.0	SEC
161			0.0	SEC
162			0.0	SEC
163			0.0	SEC
164			0.0	SEC
165			0.0	SEC
166			0.0	SEC
167			0.0	SEC
168			0.0	SEC
169			0.0	SEC
170			0.0	SEC

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
171	PXCS (20)	PILOT LONG. STICK DISPLACEMENT (+) AFT	0.0	FT
172			0.0	FT
173			4.2000E-02	FT
174			4.2000E-02	FT
175			0.0	FT
176			0.0	FT
177			0.0	FT
178			0.0	FT
179			0.0	FT
180			0.0	FT
181			0.0	FT
182			0.0	FT
183			0.0	FT
184			0.0	FT
185			0.0	FT
186			0.0	FT
187			0.0	FT
188			0.0	FT
189			0.0	FT
190			0.0	FT
191	PYCS (20)	PILOT LAT. STICK DISPLACEMENT (+) RT	0.0	FT
192			0.0	FT
193			0.0	FT
194			0.0	FT
195			0.0	FT
196			0.0	FT
197			0.0	FT
198			0.0	FT
199			0.0	FT
200			0.0	FT
201			0.0	FT
202			0.0	FT
203			0.0	FT
204			0.0	FT
205			0.0	FT
206			0.0	FT
207			0.0	FT
208			0.0	FT
209			0.0	FT
210			0.0	FT
211	PTHO (20)	PILOT COLLECTIVE INPUT (+) THRUST	0.0	RAD
212			0.0	RAD
213			0.0	RAD
214			0.0	RAD
215			0.0	RAD

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
216			0.0	RAD
217			0.0	RAD
218			0.0	RAD
219			0.0	RAD
220			0.0	RAD
221			0.0	RAD
222			0.0	RAD
223			0.0	RAD
224			0.0	RAD
225			0.0	RAD
226			0.0	RAD
227			0.0	RAD
228			0.0	RAD
229			0.0	RAD
230			0.0	RAD
231	PTHOTR(20)	PILOT TAIL ROTOR COLL. INPUT (+) THRUST	0.0	RAD
232			0.0	RAD
233			0.0	RAD
234			0.0	RAD
235			0.0	RAD
236			0.0	RAD
237			0.0	RAD
238			0.0	RAD
239			0.0	RAD
240			0.0	RAD
241			0.0	RAD
242			0.0	RAD
243			0.0	RAD
244			0.0	RAD
245			0.0	RAD
246			0.0	RAD
247			0.0	RAD
248			0.0	RAD
249			0.0	RAD
250			0.0	RAD
251	PBP (20)	PILOT PROP. BLADE ANGLE INPUT (+) THRUST	0.0	RAD
252			0.0	RAD
253			0.0	RAD
254			0.0	RAD
255			0.0	RAD
256			0.0	RAD
257			0.0	RAD
258			0.0	RAD
259			0.0	RAD
260			0.0	RAD
261			0.0	RAD

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
262			0.0	RAD
263			0.0	RAD
264			0.0	RAD
265			0.0	RAD
266			0.0	RAD
267			0.0	RAD
268			0.0	RAD
269			0.0	RAD
270			0.0	RAD
271	DOE0	SWP TO FEATHER GEAR RATIO AT ZERO COLLECTIVE	1.0000E 00	
272	DOE1	VARIATION OF D/E WITH COLL.	0.0	1/RAD
273	FKSPT	SHAFT BENDING FLEXIBILITY	0.0	
274	YTR	TAIL ROTOR LATERAL OFFSET +RT	-2.4000E 00	FT
275	FBL1I (2,2)	FEATHER BEARING INPL. MODE INBOARD Y DISPL +FWD	1.9810E-02	
276		INBOARD Z DISPL +DN	-3.7420E-05	
277		OUTBOARD Y DISPL +FWD	3.9620E-02	
278		OUTBOARD Z DISPL +DN	-7.4900E-05	
279	FBL1F (2,2)	FEATHER BEARING 1ST FLAP MODE	-4.1770E-05	
280			1.9610E-02	
281			-8.3580E-05	
282			3.9230E-02	
283	FBL2F (2,2)	FEATHER BEARING 2ND FLAP MODE	-1.0040E-02	
284			-3.9880E-02	
285			-2.0070E-02	
286			-7.9750E-02	
287	TC (5)	DOWNWASH TIME CONSTANT (TRIM)	1.0000E 00	SEC
288		DOWNWASH TIME CONSTANT (FLY)	5.0000E-02	SEC
289		TR FLAP TIME CONSTANT	1.0000E-01	SEC
290		SHAFT BENDING TRIM TIME CONST	0.0	SEC
291		NOT USED	0.0	
292	TCX	PILOT LONGITUDINAL ACTUATOR TIME CONSTANT	2.5000E-02	SEC
293	TCY	PILOT LATERAL ACTUATOR TIME CONSTANT	2.5000E-02	SEC
294	TXS	FEATHER SPRING	0.0	FT-LB/RD
295	PRI	SPECIFIED TRIM ROLL RATE +RT	0.0	RAD/SEC

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
296	QRI	SPECIFIED TRIM PITCH RATE +UP	0.0	RAD/SEC
297	DSTAF	BL.STA. FOR EFFECTIVE SWEEP AND DROOP OUTPUT	2.1000E 01	FT
298	TSCLE	PLOT SCALE FACTOR (ABSCISSA) UNITS PER INCH OF PLOT	1.0000E 00	
299	NVAR1	NO. PARAMS. TO BE PLOTTED IN TRIM	3.0000E 01	
300	NVAR2	NO. PARAMS. TO BE PLOTTED IN FLY	5.0000E 01	
301	NVEC1 (40)	CODE NO. OF PARAM. TO BE PLOTTED IN TRIM	1.0000E 00	
302			2.0000E 00	
303			3.0000E 00	
304			4.0000E 00	
305			1.0000E 01	
306			1.1000E 01	
307			1.2000E 01	
308			5.0000E 00	
309			8.0000E 00	
310			9.0000E 00	
311			6.0000E 00	
312			7.9000E 01	
313			5.3000E 01	
314			5.5000E 01	
315			5.6000E 01	
316			8.0000E 01	
317			1.3000E 01	
318			9.0000E 01	
319			8.1000E 01	
320			4.7000E 01	
321			7.0000E 00	
322			8.5000E 01	
323			8.6000E 01	
324			8.7000E 01	
325			8.8000E 01	
326			8.9000E 01	
327			1.4000E 01	
328			1.5000E 01	
329			5.1000E 01	
330			5.2000E 01	
331			0.0	
332			0.0	
333			0.0	
334			0.0	
335			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
336			0.0	
337			0.0	
338			0.0	
339			0.0	
340			0.0	
341	OPEN		0.0	
342	QKXCSG	LONG. STICK SPRING FOR CONTROL GYRO COMMAND	0.0	FT-LB/FT
343	QKYCSG	LAT. STICK SPRING FOR CONTROL GYRO COMMAND	0.0	FT-LB/FT
344	PSIPG	SWP ACTUATOR PHASE ANGLE CONTROL GYRO SIMUL.	0.0	RAD
345	CHIG	STICK-TO-GYRO PHASE ANGLE (+) GYRO LEADS STICK	0.0	RAD
346	ZOBL	Z-DISPL OF BLADE COORD SYSTEMS REL. TO ROTOR SYSTEM	0.0	FT
347	MUB	GYRO UNBALANCED MASS	0.0	SLUG
348	PXPZ	X-OFFSET OF UNBALANCED GYRO MASS (+) FWD	0.0	FT
349	PYPZ	Y-OFFSET OF UNBALANCED GYRO MASS (+) RT	0.0	FT
350	IZZGR	GYRO POLAR INERTIA	0.0	SLUG-FT2
351	TAUACT	SWP ACTUATOR TIME CONST FOR CONTROL GYRO SIMULATION	0.0	SEC
352	GSKL	GYRO SPRING,ROLL AXIS	0.0	FT-LB/RD
353	GSDL	GYRO SPRING,ROLL-PITCH COUPLING	0.0	FT-LB/RD
354	GFDDL	GYRO DAMPER,ROLL-PITCH COUPLING	0.0	F-LB/R/S
355	GSKM	GYRO SPRING,PITCH-ROLL COUPLING	0.0	FT-LB/RD
356	GSDM	GYRO SPRING,PITCH AXIS	0.0	FT-LB/RD

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION			SAMPLE VALUE	UNITS
357	GFKDM	GYRO DAMPER,PITCH-ROLL COUPLING			0.0	F-LB/R/S
358	GFDDM	GYRO DAMPER,PITCH AXIS			0.0	F-LB/R/S
359	GFKDL	GYRO DAMPER,ROLL AXIS			0.0	F-LB/R/S
360	IZZGNR	GYRO POLAR INERTIA, NON-ROTATING			0.0	SLUG-FT2
361	IXXG	SWP ROLL INERTIA			0.0	SLUG-FT2
362	GRK	GYRO ROLL-TO-SWASHPLATE GEAR RATIO			0.0	
363	GRD	GYRO PITCH-TO-SWASHPLATE GEAR RATIO			0.0	
364	XTHTF	PARTIAL(X-FUSELAGE/THETA-SHFT)			0.0	
365	YPHIF	PARTIAL(Y-FUSELAGE/PHI-SHAFT)			0.0	
366	HMASS	MASS OF THE HUB			1.0000E 01	SLUG
367	OPEN (4)				0.0	
368					0.0	
369					0.0	
370					0.0	
371	CLAG	INPLANE LAG DAMPER CONSTANT			2.5722E 04	F-LB/R/S
372	XFBAR	CG LOCATION IN	XF	+FWD	6.0000E-01	FT
373	YFBAR	FUSELAGE	YF	+RT	0.0	FT
374	ZFBAR	COORDINATES	ZF	+DN	0.0	FT
375	FKS	SHAFT BENDING SPRING			1.0000E 00	FT-LB/RD
376	KPHCON	SWASHPLATE SPRING (ROLL) IN CONTROL AXIS			1.0000E 00	FT-LB/RD
377	KTHCON	SWASHPLATE SPRING (PITCH) IN CONTROL AXIS			1.0000E 00	FT-LB/RD
378	CPHDSP	SWASHPLATE DAMPER (ROLL) IN CONTROL AXIS			0.0	F-LB/R/S
379	CTHDSP	SWASHPLATE DAMPER (PITCH) IN CONTROL AXIS			0.0	F-LB/R/S

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
380	OPEN (15)		0.0	
381			0.0	
382			0.0	
383			0.0	
384			0.0	
385			0.0	
386			0.0	
387			0.0	
388			0.0	
389			0.0	
390			0.0	
391			0.0	
392			0.0	
393			0.0	
394			0.0	
395	KFPHG	GYRO STICTION	0.0	LB
396	RFBL	RADIUS AT INBOARD END OF FEEDBACK LEVER	0.0	FT
397	PSIFBL	AZIMUTH INBOARD END OF FEEDBACK LEVER. LEADS BLADE	0.0	RAD
398	CAPHIS	SHAFT TO SWP COUPLING	0.0	
399	IFLEX	SHAFT BENDING FLAG 0=OFF,1=ON	0.0	
400	OPEN (37)		0.0	
401			0.0	
402			0.0	
403			0.0	
404			0.0	
405			0.0	
406			0.0	
407			0.0	
408			0.0	
409			0.0	
410			0.0	
411			0.0	
412			0.0	
413			0.0	
414			0.0	
415			0.0	
416			0.0	
417			0.0	
418			0.0	
419			0.0	
420			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL		DESCRIPTION	SAMPLE VALUE	UNITS
421				0.0	
422				0.0	
423				0.0	
424				0.0	
425				0.0	
426				0.0	
427				0.0	
428				0.0	
429				0.0	
430				0.0	
431				0.0	
432				0.0	
433				0.0	
434				0.0	
435				0.0	
436				0.0	
437	XCPDL		MAX.LONG.STICK ACTUATOR RATE LIMIT	1.0000E 03	FT/SEC
438	YCPDL		MAX.LAT.STICK ACTUATOR RATE LIMIT	1.0000E 03	FT/SEC
439	OPEN			0.0	
440	FAST		SINGLE BLADE TRIM FLAG 0=OFF,1=ON	0.0	
441	FMN	(1,1)	BODY AIRLOADS COEFF MATRIX FX DUE TO ASYMMETRY +FWD	0.0	
442		(2,1)	FY DUE TO ASYMMETRY + RT	0.0	
443		(3,1)	FZ DUE TO ASYMMETRY + DN	0.0	
444		(4,1)	MX DUE TO ASYMMETRY + RT	0.0	
445		(5,1)	MY DUE TO ASYMMETRY + N.UP	0.0	
446		(6,1)	MZ DUE TO ASYMMETRY + N.RT	0.0	
447	FMN	(1,2)	LOADS DUE TO QUADRATIC SIDESLIP	0.0	
448				0.0	
449				0.0	
450				0.0	
451				0.0	
452				0.0	
453	FMN	(1,3)	LOADS DUE TO LINEAR SIDESLIP	0.0	
454				-2.0000E-01	
455				0.0	
456				0.0	
457				0.0	
458				0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
459	FMN (1,4)	LOADS DUE TO WING ROLL DAMPING	0.0	
460			0.0	
461			0.0	
462			0.0	
463			0.0	
464			0.0	
465	FMN (1,5)	LOADS DUE TO HORIZONTAL TAIL	0.0	
466			0.0	
467			-3.6000E-02	
468			0.0	
469			-1.0000E 00	
470			0.0	
471	FMN (1,6)	LOADS DUE TO VERTICAL TAIL	0.0	
472			-5.9000E-02	
473			0.0	
474			0.0	
475			0.0	
476			1.6700E 00	
477	OPEN (13)		0.0	
478			0.0	
479			0.0	
480			0.0	
481			0.0	
482			0.0	
483			0.0	
484			0.0	
485			0.0	
486			0.0	
487			0.0	
488			0.0	
489			0.0	
490	IAMCS	FLAG FOR AMCS (ISOLATED GYRO) 1 = AMCS SIMULATION	0.0	
491	OPEN (3)		0.0	
492			0.0	
493			0.0	
494	YCSMAX	LATERAL STICK TRAVEL LIMIT	1.0000E 03	FT
495	OPEN (3)		0.0	
496			0.0	
497			0.0	
498	NRAD	NO. OF BLADE STATIONS	1.3000E 01	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
499	NINC	STATION INTERVAL USED	1.0000E 00	
500	KSTART	STARTING STATION	2.0000E 00	
501	SX (40)	BLADE STATION	1.4500E 00	FT
502			2.7500E 00	FT
503			5.5000E 00	FT
504			7.5000E 00	FT
505			9.5000E 00	FT
506			1.2000E 01	FT
507			1.3750E 01	FT
508			1.5750E 01	FT
509			1.8750E 01	FT
510			2.1500E 01	FT
511			2.4000E 01	FT
512			2.5750E 01	FT
513			2.8000E 01	FT
514			0.0	FT
515			0.0	FT
516			0.0	FT
517			0.0	FT
518			0.0	FT
519			0.0	FT
520			0.0	FT
521			0.0	FT
522			0.0	FT
523			0.0	FT
524			0.0	FT
525			0.0	FT
526			0.0	FT
527			0.0	FT
528			0.0	FT
529			0.0	FT
530			0.0	FT
531			0.0	FT
532			0.0	FT
533			0.0	FT
534			0.0	FT
535			0.0	FT
536			0.0	FT
537			0.0	FT
538			0.0	FT
539			0.0	FT
540			0.0	FT
541	OM (40)	BLADE DISTRIBUTED MASS SLUG/FT	1.7440E 00	
542			2.9280E-01	
543			1.0090E-01	
544			1.6220E-01	
545			1.6440E-01	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
546			1.5960E-01	
547			1.6890E-01	
548			1.7840E-01	
549			1.5400E-01	
550			1.5780E-01	
551			1.8560E-01	
552			1.5370E-01	
553			2.6700E-01	
554			0.0	
555			0.0	
556			0.0	
557			0.0	
558			0.0	
559			0.0	
560			0.0	
561			0.0	
562			0.0	
563			0.0	
564			0.0	
565			0.0	
566			0.0	
567			0.0	
568			0.0	
569			0.0	
570			0.0	
571			0.0	
572			0.0	
573			0.0	
574			0.0	
575			0.0	
576			0.0	
577			0.0	
578			0.0	
579			0.0	
580			0.0	
581	VEQ1	INITIAL AIRSPEED,LONG. STICK DESENSITIZER	0.0	FT/SEC
582	DVEQ1	DEFINES THE TRANSITION FROM NO CORRECTION TO FULL CORRECT.	0.0	FT/SEC
583	VEQ2	INITIAL AIRSPEED PITCH-ROLL DE-COUPLER	0.0	FT/SEC
584	DVEQ2	DEFINES THE TRANSITION RANGE	0.0	FT/SEC
585	KXCS	LONG.DESENSITIZER FEEDBACK RATIO	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL		DESCRIPTION	SAMPLE VALUE	UNITS
586	KYCS		LAT. DESENSITIZER FEEDBACK RATIO	0.0	
587	KXPR		ROLL-TO-PITCH STICK FEEDBACK RATIO	0.0	FT/R/S
588	XCS1		LONG. DESENSITIZER LIMIT	0.0	FT
589	XCS2		LONG. DESENSITIZER PLUS PITCH-ROLL DECOUPLER LIMIT	0.0	FT
590	YCS1		LAT. DESENSITIZER LIMIT	0.0	FT
591	PQENG		TORQUE VS GEN. SPEED RATIO	0.0	F-LB/R/S
592	PQEOM		TORQUE VS ROTOR SPEED RATIO	0.0	F-LB/R/S
593	K1PRM		ACCEL. FEEDBACK GAIN	0.0	
594	K2PRM		SPEED FEEDBACK GAIN	0.0	
595	TAUG		COMPRESSOR TIME CONSTANT	0.0	SEC
596	OPEN	(5)		0.0	
597				0.0	
598				0.0	
599				0.0	
600				0.0	
601	SY	(40)	BLADE ELEMENT C G LOCATION RELATIVE TO 1/4 CHORD +FWD	0.0	FT
602				0.0	FT
603				0.0	FT
604				0.0	FT
605				0.0	FT
606				0.0	FT
607				0.0	FT
608				0.0	FT
609				0.0	FT
610				0.0	FT
611				0.0	FT
612				0.0	FT
613				0.0	FT
614				0.0	FT
615				0.0	FT
616				0.0	FT
617				0.0	FT
618				0.0	FT
619				0.0	FT
620				0.0	FT

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
621			0.0	FT
622			0.0	FT
623			0.0	FT
624			0.0	FT
625			0.0	FT
626			0.0	FT
627			0.0	FT
628			0.0	FT
629			0.0	FT
630			0.0	FT
631			0.0	FT
632			0.0	FT
633			0.0	FT
634			0.0	FT
635			0.0	FT
636			0.0	FT
637			0.0	FT
638			0.0	FT
639			0.0	FT
640			0.0	FT
641	PSITR (20)	PILOT ENGINE SPEED	0.0	RAD/SEC
642			0.0	RAD/SEC
643			0.0	RAD/SEC
644			0.0	RAD/SEC
645			0.0	RAD/SEC
646			0.0	RAD/SEC
647			0.0	RAD/SEC
648			0.0	RAD/SEC
649			0.0	RAD/SEC
650			0.0	RAD/SEC
651			0.0	RAD/SEC
652			0.0	RAD/SEC
653			0.0	RAD/SEC
654			0.0	RAD/SEC
655			0.0	RAD/SEC
656			0.0	RAD/SEC
657			0.0	RAD/SEC
658			0.0	RAD/SEC
659			0.0	RAD/SEC
660			0.0	RAD/SEC
661	GLCN	GYRO ROLL CONTROL MOMENT TRIM INITIALIZATION +RT	0.0	FT-LB
662	GMCN	GYRO PITCH CONTROL MOMENT TRIM INITIALIZATION +N.UP	0.0	FT-LB
663	TEETER	TEETERING ROTOR SIMULATION 1 = ON	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
664	APHI	GAIN FACTORS IN CONTROL EQ.S A-PHI	0.0	
665	BPHI	GAIN FACTORS IN CONTROL EQ.S B-PHI	0.0	
666	APSI	GAIN FACTORS IN CONTROL EQ.S A-PSI	0.0	
667	BPSI	GAIN FACTORS IN CONTROL EQ.S B-PSI	0.0	
668	ATH	GAIN FACTORS IN CONTROL EQ.S A-THETA	0.0	
669	BTH	GAIN FACTORS IN CONTROL EQ.S B-THETA	0.0	
670	ATC	GAIN FACTORS IN CONTROL EQ.S A-THETA-C	0.0	
671	OPEN (9)		0.0	
672			0.0	
673			0.0	
674			0.0	
675			0.0	
676			0.0	
677			0.0	
678			0.0	
679			0.0	
680	NMPAT	NO. OF AUTOPILOT POINTS	0.0	
681	PTAUTO(20)	AUTOPILOT TIME	0.0	
682			0.0	
683			0.0	
684			0.0	
685			0.0	
686			0.0	
687			0.0	
688			0.0	
689			0.0	
690			0.0	
691			0.0	
692			0.0	
693			0.0	
694			0.0	
695			0.0	
696			0.0	
697			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
698			0.0	
699			0.0	
700			0.0	
701	PXCSAT(20)	AUTOPILOT LONG. STICK	0.0	
702			0.0	
703			0.0	
704			0.0	
705			0.0	
706			0.0	
707			0.0	
708			0.0	
709			0.0	
710			0.0	
711			0.0	
712			0.0	
713			0.0	
714			0.0	
715			0.0	
716			0.0	
717			0.0	
718			0.0	
719			0.0	
720			0.0	
721	PYCSAT(20)	AUTOPILOT LAT. STICK	0.0	
722			0.0	
723			0.0	
724			0.0	
725			0.0	
726			0.0	
727			0.0	
728			0.0	
729			0.0	
730			0.0	
731			0.0	
732			0.0	
733			0.0	
734			0.0	
735			0.0	
736			0.0	
737			0.0	
738			0.0	
739			0.0	
740			0.0	
741	PTHOAT(20)	AUTOPILOT COLLECTIVE	0.0	
742			0.0	
743			0.0	
744			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
745			0.0	
746			0.0	
747			0.0	
748			0.0	
749			0.0	
750			0.0	
751			0.0	
752			0.0	
753			0.0	
754			0.0	
755			0.0	
756			0.0	
757			0.0	
758			0.0	
759			0.0	
760			0.0	
761	BMSII (1,1) 40	Y, INPLANE MODE + FWD	0.0	
762			6.4000E-02	
763			1.6480E-01	
764			2.3830E-01	
765			3.1200E-01	
766			4.0440E-01	
767			4.6920E-01	
768			5.4350E-01	
769			6.5500E-01	
770			7.5750E-01	
771			8.5070E-01	
772			9.1600E-01	
773			1.0000E 00	
774			0.0	
775			0.0	
776			0.0	
777			0.0	
778			0.0	
779			0.0	
780			0.0	
781			0.0	
782			0.0	
783			0.0	
784			0.0	
785			0.0	
786			0.0	
787			0.0	
788			0.0	
789			0.0	
790			0.0	
791			0.0	
792			0.0	
793			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION		SAMPLE VALUE	UNITS
794				0.0	
795				0.0	
796				0.0	
797				0.0	
798				0.0	
799				0.0	
800				0.0	
801	BMS1I (1,2) 40	Z, INPLANE MODE	+ DN	0.0	
802				-1.2160E-04	
803				-2.4880E-04	
804				-2.6480E-04	
805				-2.5100E-04	
806				-2.1160E-04	
807				-1.7500E-04	
808				-1.2740E-04	
809				-4.3930E-05	
810				4.5900E-05	
811				1.3410E-04	
812				1.9880E-04	
813				2.8340E-04	
814				0.0	
815				0.0	
816				0.0	
817				0.0	
818				0.0	
819				0.0	
820				0.0	
821				0.0	
822				0.0	
823				0.0	
824				0.0	
825				0.0	
826				0.0	
827				0.0	
828				0.0	
829				0.0	
830				0.0	
831				0.0	
832				0.0	
833				0.0	
834				0.0	
835				0.0	
836				0.0	
837				0.0	
838				0.0	
839				0.0	
840				0.0	
841	BMS1I (1,3) 40	DY/DS, INPLANE MODE	+FWD	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
842			3.6590E-02	
843			3.6710E-02	
844			3.6810E-02	
845			3.6900E-02	
846			3.7010E-02	
847			3.7080E-02	
848			3.7150E-02	
849			3.7230E-02	
850			3.7280E-02	
851			3.7310E-02	
852			3.7310E-02	
853			3.7320E-02	
854			0.0	
855			0.0	
856			.0	
857			0.0	
858			0.0	
859			0.0	
860			0.0	
861			0.0	
862			0.0	
863			0.0	
864			0.0	
865			0.0	
866			0.0	
867			0.0	
868			0.0	
869			0.0	
870			0.0	
871			0.0	
872			0.0	
873			0.0	
874			0.0	
875			0.0	
876			0.0	
877			0.0	
878			0.0	
879			0.0	
880			0.0	
881	BMS1I (1,4) 40	DZ/DS, INPLANE MODE +DN	0.0	
882			-7.0530E-05	
883			-1.9390E-05	
884			2.2200E-07	
885			1.0210E-05	
886			1.7570E-05	
887			2.1000E-05	
888			2.4570E-05	
889			2.9270E-05	
890			3.3500E-05	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
891			3.6260E-05	
892			3.7210E-05	
893			3.7550E-05	
894			0.0	
895			0.0	
896			0.0	
897			0.0	
898			0.0	
899			0.0	
900			0.0	
901			0.0	
902			0.0	
903			0.0	
904			0.0	
905			0.0	
906			0.0	
907			0.0	
908			0.0	
909			0.0	
910			0.0	
911			0.0	
912			0.0	
913			0.0	
914			0.0	
915			0.0	
916			0.0	
917			0.0	
918			0.0	
919			0.0	
920			0.0	
921	BMS1F (1,1) 40	Y, 1ST FLAP MODE + FWD	0.0	
922			-1.3550E-04	
923			-2.8560E-04	
924			-3.1840E-04	
925			-3.1760E-04	
926			-2.8940E-04	
927			-2.5480E-04	
928			-2.0230E-04	
929			-9.8390E-05	
930			2.2580E-05	
931			1.5120E-04	
932			2.4840E-04	
933			3.7700E-04	
934			0.0	
935			0.0	
936			0.0	
937			0.0	
938			0.0	
939			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
940			0.0	
941			0.0	
942			0.0	
943			0.0	
944			0.0	
945			0.0	
946			0.0	
947			0.0	
948			0.0	
949			0.0	
950			0.0	
951			0.0	
952			0.0	
953			0.0	
954			0.0	
955			0.0	
956			0.0	
957			0.0	
958			0.0	
959			0.0	
960			0.0	
961	BMS1F (1,2) 40	Z, 1ST FLAP MODE + DN	0.0	
962			6.3370E-02	
963			1.6340E-01	
964			2.3660E-01	
965			3.1020E-01	
966			4.0250E-01	
967			4.6730E-01	
968			5.4160E-01	
969			6.5340E-01	
970			7.5620E-01	
971			8.4990E-01	
972			9.1560E-01	
973			1.0000E 00	
974			0.0	
975			0.0	
976			0.0	
977			0.0	
978			0.0	
979			0.0	
980			0.0	
981			0.0	
982			0.0	
983			0.0	
984			0.0	
985			0.0	
986			0.0	
987			0.0	
988			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION		SAMPLE VALUE	UNITS
989				0.0	
990				0.0	
991				0.0	
992				0.0	
993				0.0	
994				0.0	
995				0.0	
996				0.0	
997				0.0	
998				0.0	
999				0.0	
1000				0.0	
1001	BMS1F (1,3) 40	DY/DS, 1ST FLAP MODE	+FWD	0.0	
1002				-7.8370E-05	
1003				-2.7680E-05	
1004				-6.9320E-06	
1005				5.7340E-06	
1006				1.6650E-05	
1007				2.2910E-05	
1008				2.9700E-05	
1009				3.9660E-05	
1010				4.8210E-05	
1011				5.4090E-05	
1012				5.6320E-05	
1013				5.7190E-05	
1014				0.0	
1015				0.0	
1016				0.0	
1017				0.0	
1018				0.0	
1019				0.0	
1020				0.0	
1021				0.0	
1022				0.0	
1023				0.0	
1024				0.0	
1025				0.0	
1026				0.0	
1027				0.0	
1028				0.0	
1029				0.0	
1030				0.0	
1031				0.0	
1032				0.0	
1033				0.0	
1034				0.0	
1035				0.0	
1036				0.0	
1037				0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION		SAMPLE VALUE	UNITS
1038				0.0	
1039				0.0	
1040				0.0	
1041	BMS1F (1,4) 40	DZ/DS, 1ST FLAP MODE	+DN	0.0	
1042				3.6220E-02	
1043				3.6530E-02	
1044				3.6700E-02	
1045				3.6850E-02	
1046				3.7000E-02	
1047				3.7100E-02	
1048				3.7200E-02	
1049				3.7330E-02	
1050				3.7430E-02	
1051				3.7500E-02	
1052				3.7520E-02	
1053				3.7530E-02	
1054				0.0	
1055				0.0	
1056				0.0	
1057				0.0	
1058				0.0	
1059				0.0	
1060				0.0	
1061				0.0	
1062				0.0	
1063				0.0	
1064				0.0	
1065				0.0	
1066				0.0	
1067				0.0	
1068				0.0	
1069				0.0	
1070				0.0	
1071				0.0	
1072				0.0	
1073				0.0	
1074				0.0	
1075				0.0	
1076				0.0	
1077				0.0	
1078				0.0	
1079				0.0	
1080				0.0	
1081	BMS2F (1,1) 40	Y, 2ND FLAP MODE	+ FWD	0.0	
1082				-3.2390E-02	
1083				-7.9960E-02	
1084				-1.0820E-01	
1085				-1.2870E-01	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1086			-1.3990E-01	
1087			-1.3700E-01	
1088			-1.2140E-01	
1089			-7.2740E-02	
1090			-2.6070E-03	
1091			7.8100E-02	
1092			1.4070E-01	
1093			2.2410E-01	
1094			0.0	
1095			0.0	
1096			0.0	
1097			0.0	
1098			0.0	
1099			0.0	
1100			0.0	
1101			0.0	
1102			0.0	
1103			0.0	
1104			0.0	
1105			0.0	
1106			0.0	
1107			0.0	
1108			0.0	
1109			0.0	
1110			0.0	
1111			0.0	
1112			0.0	
1113			0.0	
1114			0.0	
1115			0.0	
1116			0.0	
1117			0.0	
1118			0.0	
1119			0.0	
1120			0.0	
1121	BMS2F (1,2) 40	Z, 2ND FLAP MODE + DN	0.0	
1122			-1.2880E-01	
1123			-3.1990E-01	
1124			-4.3680E-01	
1125			-5.2570E-01	
1126			-5.8280E-01	
1127			-5.8060E-01	
1128			-5.2720E-01	
1129			-3.3560E-01	
1130			-3.7480E-02	
1131			3.2340E-01	
1132			6.1130E-01	
1133			1.0000E 00	
1134			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1135			0.0	
1136			0.0	
1137			0.0	
1138			0.0	
1139			0.0	
1140			0.0	
1141			0.0	
1142			0.0	
1143			0.0	
1144			0.0	
1145			0.0	
1146			0.0	
1147			0.0	
1148			0.0	
1149			0.0	
1150			0.0	
1151			0.0	
1152			0.0	
1153			0.0	
1154			0.0	
1155			0.0	
1156			0.0	
1157			0.0	
1158			0.0	
1159			0.0	
1160			0.0	
1161	BMS2F (1,3) 40	DY/DS, 2ND FLAP MODE +FWD	0.0	
1162			-1.8420E-02	
1163			-1.5640E-02	
1164			-1.2300E-02	
1165			-7.7510E-03	
1166			-9.1720E-04	
1167			4.5000E-03	
1168			1.1190E-02	
1169			2.1210E-02	
1170			2.9390E-02	
1171			3.4550E-02	
1172			3.6380E-02	
1173			3.7070E-02	
1174			0.0	
1175			0.0	
1176			0.0	
1177			0.0	
1178			0.0	
1179			0.0	
1180			0.0	
1181			0.0	
1182			0.0	
1183			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1184			0.0	
1185			0.0	
1186			0.0	
1187			0.0	
1188			0.0	
1189			0.0	
1190			0.0	
1191			0.0	
1192			0.0	
1193			0.0	
1194			0.0	
1195			0.0	
1196			0.0	
1197			0.0	
1198			0.0	
1199			0.0	
1200			0.0	
1201	BMS2F (1,4)	40 DZ/DS, 2ND FLAP MODE +DN	0.0	
1202			-7.3380E-02	
1203			-6.3760E-02	
1204			-5.1970E-02	
1205			-3.5250E-02	
1206			-9.0460E-03	
1207			1.2810E-02	
1208			4.1240E-02	
1209			8.7130E-02	
1210			1.2840E-01	
1211			1.5730E-01	
1212			1.6840E-01	
1213			1.7280E-01	
1214			0.0	
1215			0.0	
1216			0.0	
1217			0.0	
1218			0.0	
1219			0.0	
1220			0.0	
1221			0.0	
1222			0.0	
1223			0.0	
1224			0.0	
1225			0.0	
1226			0.0	
1227			0.0	
1228			0.0	
1229			0.0	
1230			0.0	
1231			0.0	
1232			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1233			0.0	
1234			0.0	
1235			0.0	
1236			0.0	
1237			0.0	
1238			0.0	
1239			0.0	
1240			0.0	
1241	BLADK (3,3)	BLADE STIFFNESS MATRIX	1.3910E 01	FT-LB
1242			6.8610E-03	FT-LB
1243			5.8230E-01	FT-LB
1244			6.8610E-03	FT-LB
1245			1.3270E-02	FT-LB
1246			1.2710E 00	FT-LB
1247			5.8230E-01	FT-LB
1248			1.2710E 00	FT-LB
1249			3.2610E 02	FT-LB
1250	CTRIM	BLADE MODE DAMPING AFTER 1 SEC OF TRIM	5.7000E-04	F-LB/R/S
1251	CFLY	BLADE MODE DAMPING DURING FLY	5.7000E-04	F-LB/R/S
1252	CZERO	BLADE MODE DAMPING AT TRIM INITIALIZATION	5.7000E-04	F-LB/R/S
1253	CONK	TAIL ROTOR (DELTA 3) FLAP-FEATHER COUPLING	0.0	
1254	OPEN (2)		0.0	
1255			0.0	
1256	DCMR	INCREMENTAL BLADE CM FOR TAB	0.0	
1257	IHAFLG	FLAG FOR HARMONIC ANALYSIS 0=OFF,1=ON	1.0000E 00	
1258	OPEN (4)		0.0	
1259			0.0	
1260			0.0	
1261			0.0	
1262	IHAPLT	HARM.ANAL.PLOT FLAG,0=NONE	0.0	
1263	DGDHG	SWP ROTARY-TO-VERT. DAMPING LB/(FT-LB-RAD)	0.0	
1264	DELCD	BLADE ELEMENT CD ADJUSTMENT	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION		SAMPLE VALUE	UNITS
1265	OPEN			0.0	
1266	BETA	BLADE CONE ANGLE	+UP	0.0	DEG
1267	TAU	BLADE SWEEP ANGLE	+FWD	0.0	DEG
1268	GAMMA	BLADE DROOP ANGLE	+DN	0.0	DEG
1269	PHIREF	BLADE REFERENCE FEATHER ANGLE +N.UP		1.5000E 01	DEG
1270	BFAS	BLADE BEARING CONE ANGLE	+UP	0.0	DEG
1271	OPEN (5)			0.0	
1272				0.0	
1273				0.0	
1274				0.0	
1275				0.0	
1276	GASTOP	SWP STOP CONTACT ANGLE		0.0	RAD
1277	GKSTOP	SWP STOP SPRING CONSTANT		0.0	FT-LB/RD
1278	RRK	YAW DAMPER GAIN		0.0	
1279	TWTR	TAIL ROTOR WASHOUT TIME		5.0000E 00	SEC
1280	TCTRA	TAIL ROTOR ACTUATOR TIME CONST		3.5000E-02	SEC
1281	OPEN (5)			0.0	
1282				0.0	
1283				0.0	
1284				0.0	
1285				0.0	
1286	******	PH OR TORSION NAT. FREQ, HARMONIC TRIM		0.0	RAD/SEC
1287	OPEN (4)			0.0	
1288				0.0	
1289				0.0	
1290				0.0	
1291	SS	SPEED OF SOUND		1.0980E 03	FT/SEC
1292	OPEN (8)			0.0	
1293				0.0	
1294				0.0	
1295				0.0	
1296				0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1297			0.0	
1298			0.0	
1299			0.0	
1300	IBLADE	DELTA CM OPTION FLAG	0.0	
1301	BI (40)	BLADE DISTRIBUTED MOMENT OF INERTIA ABOUT CG, SLUG-FT	1.4660E-01	
1302			1.1210E-02	
1303			9.7770E-03	
1304			1.6950E-02	
1305			1.6120E-02	
1306			1.6440E-02	
1307			1.7060E-02	
1308			1.7920E-02	
1309			1.5180E-02	
1310			1.5410E-02	
1311			1.8140E-02	
1312			1.5270E-02	
1313			2.7680E-02	
1314			0.0	
1315			0.0	
1316			0.0	
1317			0.0	
1318			0.0	
1319			0.0	
1320			0.0	
1321			0.0	
1322			0.0	
1323			0.0	
1324			0.0	
1325			0.0	
1326			0.0	
1327			0.0	
1328			0.0	
1329			0.0	
1330			0.0	
1331			0.0	
1332			0.0	
1333			0.0	
1334			0.0	
1335			0.0	
1336			0.0	
1337			0.0	
1338			0.0	
1339			0.0	
1340			0.0	
1341	DCOEF (4)	DAMPING COEFFICIENTS, HARMONIC TRIM	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION		SAMPLE VALUE	UNITS
1342				0.0	
1343				0.0	
1344				0.0	
1345	KTI	BLADE INBOARD TAB STATION NO.		0.0	
1346	KTO	BLADE OUTBOARD TAB STATION NO.		0.0	
1347	DCMR1	DELTA CM. CAN BE OPTIONALLY USED. SEE RA(1300)		0.0	
1348	HTR	HEIGHT OF THE TAIL ROTOR	+UP	4.7500E 00	FT
1349	YP	PROP LAT. OFFSET	+RT	0.0	FT
1350	THRCON	PROP THRUST CONSTANT		0.0	
1351	TORCON	PROP TORQUE CONSTANT		0.0	
1352	PARCON	PROP ADVANCE RATIO CONSTANT		0.0	
1353	OPEN (8)			0.0	
1354				0.0	
1355				0.0	
1356				0.0	
1357				0.0	
1358				0.0	
1359				0.0	
1360				0.0	
1361	DSOGJ (40)	RECIPROCAL OF TORSIONAL STIFFNESS GJ		0.0	
1362				0.0	
1363				0.0	
1364				0.0	
1365				0.0	
1366				0.0	
1367				0.0	
1368				0.0	
1369				0.0	
1370				0.0	
1371				0.0	
1372				0.0	
1373				0.0	
1374				0.0	
1375				0.0	
1376				0.0	
1377				0.0	
1378				0.0	
1379				0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1380			0.0	
1381			0.0	
1382			0.0	
1383			0.0	
1384			0.0	
1385			0.0	
1386			0.0	
1387			0.0	
1388			0.0	
1389			0.0	
1390			0.0	
1391			0.0	
1392			0.0	
1393			0.0	
1394			0.0	
1395			0.0	
1396			0.0	
1397			0.0	
1398			0.0	
1399			0.0	
1400			0.0	
1401	TCT	QUASI-STATIC TORSION TIME CONSTANT	0.0	SEC
1402	DTH1	BL. STA 1 FOR ELASTIC TWIST OUTPUT	0.0	FT
1403	DTH2	BL. STA 2 FOR ELASTIC TWIST OUTPUT	0.0	FT
1404	TTFLAG	TENSION-TORSION PACK OPTION 0=OFF , 1=ON	0.0	
1405	OPEN (4)		0.0	
1406			0.0	
1407			0.0	
1408			0.0	
1409	YIV1	INPL DISPL,TT PACK INBD END MODE 1,+FWD	0.0	
1410	YIV2	MODE 2,+FWD	0.0	
1411	YIV3	MODE 3,+FWD	0.0	
1412	ZIV1	OUTPL DISPL,TT PACK INBD END MODE 1,+DN	0.0	
1413	ZIV2	MODE 2,+DN	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1414	ZIV3	MODE 3,+DN	0.0	
1415	YOV1	INPL DISPL,TT PACK OUTBD END MODE 1,+FWD	0.0	
1416	YOV2	MODE 2,+FWD	0.0	
1417	YOV3	MODE 3,+FWD	0.0	
1418	ZOV1	OUTPL DISPL,TT PACK OUTBD END MODE 1,+DN	0.0	
1419	ZOV2	MODE 2,+DN	0.0	
1420	ZOV3	MODE 3,+DN	0.0	
1421	YCS (40)	DISTANCE C.G. TO SHEAR CENTER +FWD	0.0	FT
1422			0.0	FT
1423			0.0	FT
1424			0.0	FT
1425			0.0	FT
1426			0.0	FT
1427			0.0	FT
1428			0.0	FT
1429			0.0	FT
1430			0.0	FT
1431			0.0	FT
1432			0.0	FT
1433			0.0	FT
1434			0.0	FT
1435			0.0	FT
1436			0.0	FT
1437			0.0	FT
1438			0.0	FT
1439			0.0	FT
1440			0.0	FT
1441			0.0	FT
1442			0.0	FT
1443			0.0	FT
1444			0.0	FT
1445			0.0	FT
1446			0.0	FT
1447			0.0	FT
1448			0.0	FT
1449			0.0	FT
1450			0.0	FT
1451			0.0	FT
1452			0.0	FT
1453			0.0	FT

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1454			0.0	FT
1455			0.0	FT
1456			0.0	FT
1457			0.0	FT
1458			0.0	FT
1459			0.0	FT
1460			0.0	FT
1461	IXXF	FUSELAGE MOM INERTIA,ROLL	5.8950E 03	SLUG-FT2
1462	IYYF	FUSELAGE MOM INERTIA,PITCH	2.7500E 04	SLUG-FT2
1463	IZZF	FUSELAGE MOM INERTIA,YAW	2.3088E 04	SLUG-FT2
1464	IXYF	FUSELAGE MOM INERTIA,R - P	0.0	SLUG-FT2
1465	IXZF	FUSELAGE MOM INERTIA,R - Y	0.0	SLUG-FT2
1466	IYZF	FUSELAGE MOM INERTIA,P - Y	0.0	SLUG-FT2
1467	OPEN		0.0	
1468	IZZH	HUB POLAR INERTIA	0.0	SLUG-FT2
1469	ZGS	HUB-TO-SWASHPLATE C.G.	0.0	FT
1470	IXXPRO,PROFLG	PROP MOM INERTIA 0= NO PROP SIMULATION	0.0	SLUG-FT2
1471	IXXENG	ENGINE MOMENT OF INERTIA	0.0	SLUG-FT2
1472	IYYTR	TAIL ROTOR MOMENT OF INERTIA	0.0	SLUG-FT2
1473	GRPRO	GEAR RATIO, PROPELLER +TOP LT	0.0	
1474	GRENG	ENGINE +TOP LT	1.0000E 00	
1475	GRTR	TAIL ROTOR +TOP RT	6.0000E 00	
1476	OPEN		0.0	
1477	ZBPH	PITCH HORN PARTIAL	0.0	
1478	AKPH	DYNAMIC PITCH HORN SPRING	0.0	FT-LB/RD
1479	DELZOB	OUTBOARD BEARING OFFSET ADJUSTMENT +UP	0.0	FT
1480	IPHORN	FLAG FOR PITCH HORN 0=OFF,1=ON	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1481	YJOG	BLADE CHORDWISE OFFSET + TIP FWD	0.0	FT
1482	ZJOG	BLADE FLAPWISE OFFSET + TIP UP	0.0	FT
1483	IFFT	SIGNAL PREPARATION FOR POST REXOR PROCESSING	0.0	
1484	ENGHPX	MAXIMUM ENGINE HORSEPOWER	0.0	
1485	CFB	FEATHERING VISCOUS FRICTION	0.0	F-LB/R/S
1486	OPEN		0.0	
1487	KPH	QUASI-STATIC PITCH HORN SPRING AND FLAG,0=NO QUASI	0.0	FT-LB/RD
1488	TPH	QUASI-STATIC PITCH HORN TIME CONSTANT	0.0	SEC
1489	OPEN (2)		0.0	
1490			0.0	
1491	RTWANG(3)	REACTIONLESS INPLANE EXCITATION	0.0	FT
1492			0.0	FT
1493			0.0	FT
1494	FIDDLE	SWP VERTICAL CENTERING LOAD	0.0	LB
1495	OPEN (2)		0.0	
1496			0.0	
1497	TORFLG	QUASI-STATIC TORSION FLAG 0=OFF,1=ON	0.0	
1498	TSTOP	MAXIMUM TIME IN FLY SEGMENT	0.0	SEC
1499	IDECUP	LIFT-ROLL DECOUPLER FLAG 0=OFF,1=ON	0.0	
1500	OPEN		0.0	
1501	TTB (20)	THETA COMMAND - USE IN CONJUNCTION WITH RA(151)	0.0	RAD
1502			0.0	RAD
1503			0.0	RAD
1504			0.0	RAD
1505			0.0	RAD

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1506			0.0	RAD
1507			0.0	RAD
1508			0.0	RAD
1509			0.0	RAD
1510			0.0	RAD
1511			0.0	RAD
1512			0.0	RAD
1513			0.0	RAD
1514			0.0	RAD
1515			0.0	RAD
1516			0.0	RAD
1517			0.0	RAD
1518			0.0	RAD
1519			0.0	RAD
1520			0.0	RAD
1521	YNA (20)	LOCATION OF NEUTRAL AXIS RELATIVE TO 1/4 CHORD +FWD	0.0	FT
1522			0.0	FT
1523			0.0	FT
1524			0.0	FT
1525			0.0	FT
1526			0.0	FT
1527			0.0	FT
1528			0.0	FT
1529			0.0	FT
1530			0.0	FT
1531			0.0	FT
1532			0.0	FT
1533			0.0	FT
1534			0.0	FT
1535			0.0	FT
1536			0.0	FT
1537			0.0	FT
1538			0.0	FT
1539			0.0	FT
1540			0.0	FT
1541	OPEN (120)		0.0	
1542			0.0	
1543			0.0	
1544			0.0	
1545			0.0	
1546			0.0	
1547			0.0	
1548			0.0	
1549			0.0	
1550			0.0	
1551			0.0	
1552			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1553			0.0	
1554			0.0	
1555			0.0	
1556			0.0	
1557			0.0	
1558			0.0	
1559			0.0	
1560			0.0	
1561			0.0	
1562			0.0	
1563			0.0	
1564			0.0	
1565			0.0	
1566			0.0	
1567			0.0	
1568			0.0	
1569			0.0	
1570			0.0	
1571			0.0	
1572			0.0	
1573			0.0	
1574			0.0	
1575			0.0	
1576			0.0	
1577			0.0	
1578			0.0	
1579			0.0	
1580			0.0	
1581			0.0	
1582			0.0	
1583			0.0	
1584			0.0	
1585			0.0	
1586			0.0	
1587			0.0	
1588			0.0	
1589			0.0	
1590			0.0	
1591			0.0	
1592			0.0	
1593			0.0	
1594			0.0	
1595			0.0	
1596			0.0	
1597			0.0	
1598			0.0	
1599			0.0	
1600			0.0	
1601			0.0	
1602			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1603			0.0	
1604			0.0	
1605			0.0	
1606			0.0	
1607			0.0	
1608			0.0	
1609			0.0	
1610			0.0	
1611			0.0	
1612			0.0	
1613			0.0	
1614			0.0	
1615			0.0	
1616			0.0	
1617			0.0	
1618			0.0	
1619			0.0	
1620			0.0	
1621			0.0	
1622			0.0	
1623			0.0	
1624			0.0	
1625			0.0	
1626			0.0	
1627			0.0	
1628			0.0	
1629			0.0	
1630			0.0	
1631			0.0	
1632			0.0	
1633			0.0	
1634			0.0	
1635			0.0	
1636			0.0	
1637			0.0	
1638			0.0	
1639			0.0	
1640			0.0	
1641			0.0	
1642			0.0	
1643			0.0	
1644			0.0	
1645			0.0	
1646			0.0	
1647			0.0	
1648			0.0	
1649			0.0	
1650			0.0	
1651			0.0	
1652			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL		DESCRIPTION	SAMPLE VALUE	UNITS
1653				0.0	
1654				0.0	
1655				0.0	
1656				0.0	
1657				0.0	
1658				0.0	
1659				0.0	
1660				0.0	
1661	Y	(30)	DISPL. EACH D.O.F.	-4.1294E 00	
1662				-2.7224E 00	
1663				-2.0041E-02	
1664				0.0	
1665				-4.4438E 00	
1666				1.2488E 00	
1667				1.8730E-01	
1668				0.0	
1669				-4.4984E 00	
1670				-1.6319E 00	
1671				1.5757E-01	
1672				0.0	
1673				-4.0000E 00	
1674				-5.9798E 00	
1675				1.7137E-01	
1676				0.0	
1677				9.4265E-02	
1678				3.1704E-02	
1679				0.0	
1680				0.0	
1681				1.2284E 02	
1682				0.0	
1683				-6.2315E 00	
1684				0.0	
1685				0.0	
1686				0.0	
1687				-1.4815E-01	
1688				-5.0130E-02	
1689				0.0	
1690				0.0	
1691	YD	(30)	VEL. EACH D.O.F.	-1.1501E 01	
1692				8.5060E 01	
1693				-1.2621E 00	
1694				0.0	
1695				3.1218E-01	
1696				1.1964E 01	
1697				1.3216E 00	
1698				0.0	
1699				-1.8055E-01	
1700				-8.3631E 01	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1701			-8.1126E-02	
1702			0.0	
1703			1.0838E 01	
1704			-1.3239E 01	
1705			-2.6460E-01	
1706			0.0	
1707			0.0	
1708			0.0	
1709			0.0	
1710			2.3210E 01	
1711			-4.6547E-01	
1712			-2.3527E 00	
1713			-5.6457E-03	
1714			-3.0897E-01	
1715			5.9532E-02	
1716			1.6666E-02	
1717			0.0	
1718			0.0	
1719			0.0	
1720			0.0	
1721	YDD (30)	ACC. EACH D.O.F.	2.6970E 01	
1722			1.6641E 02	
1723			2.2033E 02	
1724			0.0	
1725			1.2456E 01	
1726			-1.7118E 03	
1727			-1.6041E 02	
1728			0.0	
1729			1.4945E 02	
1730			-5.6694E 02	
1731			1.4834E 01	
1732			0.0	
1733			-1.5749E 02	
1734			2.1129E 03	
1735			-7.0873E 01	
1736			0.0	
1737			0.0	
1738			0.0	
1739			0.0	
1740			0.0	
1741			-2.0790E 00	
1742			2.3943E 00	
1743			-3.1813E 01	
1744			-3.0897E-01	
1745			5.9532E-02	
1746			1.6666E-02	
1747			0.0	
1748			0.0	
1749			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1750			0.0	
1751	FX (25)	FUSELAGE DOWNWASH AS A FUNCT. OF MAIN ROTOR WAKE ANGLE,DEG	1.8000E 01	
1752			-1.8000E 02	
1753			6.2300E-01	
1754			0.0	
1755			6.2300E-01	
1756			4.0000E 01	
1757			7.4000E-01	
1758			7.0000E 01	
1759			8.8000E-01	
1760			8.0000E 01	
1761			8.6000E-01	
1762			9.0000E 01	
1763			8.4000E-01	
1764			1.0000E 02	
1765			5.6000E-01	
1766			1.1000E 02	
1767			3.8300E-01	
1768			1.8000E 02	
1769			3.8300E-01	
1770			0.0	
1771			0.0	
1772			0.0	
1773			0.0	
1774			0.0	
1775			0.0	
1776	TNBODY(25)	HORZ TAIL DWNWASH AS A FUNCT. OF MAIN ROTOR WAKE ANGLE,DEG	2.2000E 01	
1777			-1.8000E 02	
1778			0.0	
1779			2.0000E 01	
1780			0.0	
1781			5.0000E 01	
1782			2.0000E 00	
1783			6.0000E 01	
1784			1.9200E 00	
1785			7.4000E 01	
1786			1.5200E 00	
1787			8.0000E 01	
1788			1.3400E 00	
1789			9.0000E 01	
1790			1.1400E 00	
1791			1.0000E 02	
1792			1.0800E 00	
1793			1.1000E 02	
1794			1.0400E 00	
1795			1.2000E 02	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1796			9.6000E-01	
1797			1.8000E 02	
1798			0.0	
1799			0.0	
1800			0.0	
1801	NVEC2 (50)	FLY PLOT CODE TABLE	3.0000E 00	
1802			7.0000E 00	
1803			2.1000E 01	
1804			1.4000E 01	
1805			5.4000E 01	
1806			4.0000E 00	
1807			1.6000E 01	
1808			1.5000E 01	
1809			1.8000E 01	
1810			1.9000E 01	
1811			1.7000E 01	
1812			1.3000E 01	
1813			2.9000E 01	
1814			2.8000E 01	
1815			2.7000E 01	
1816			2.6000E 01	
1817			3.0000E 01	
1818			2.5000E 01	
1819			2.4000E 01	
1820			2.3000E 01	
1821			3.6000E 01	
1822			4.8000E 01	
1823			3.8000E 01	
1824			4.0000E 01	
1825			4.2000E 01	
1826			5.2000E 01	
1827			5.1000E 01	
1828			4.7000E 01	
1829			7.1000E 01	
1830			6.9000E 01	
1831			7.0000E 01	
1832			6.8000E 01	
1833			3.1000E 01	
1834			3.2000E 01	
1835			3.9000E 01	
1836			2.0000E 01	
1837			5.8000E 01	
1838			5.7000E 01	
1839			3.4000E 01	
1840			3.3000E 01	
1841			4.5000E 01	
1842			4.4000E 01	
1843			5.0000E 01	
1844			4.9000E 01	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1845			5.6000E 01	
1846			5.5000E 01	
1847			5.3000E 01	
1848			4.1000E 01	
1849			3.7000E 01	
1850			3.5000E 01	
1851	SVEC (50)	TABLE OF PLOT SCALE FACTORS	0.0	
1852			0.0	
1853			0.0	
1854			0.0	
1855			0.0	
1856			0.0	
1857			0.0	
1858			0.0	
1859			0.0	
1860			0.0	
1861			0.0	
1862			0.0	
1863			0.0	
1864			0.0	
1865			0.0	
1866			0.0	
1867			0.0	
1868			0.0	
1869			0.0	
1870			0.0	
1871			0.0	
1872			0.0	
1873			0.0	
1874			0.0	
1875			0.0	
1876			0.0	
1877			0.0	
1878			0.0	
1879			0.0	
1880			0.0	
1881			0.0	
1882			0.0	
1883			0.0	
1884			0.0	
1885			0.0	
1886			0.0	
1887			0.0	
1888			0.0	
1889			0.0	
1890			0.0	
1891			0.0	
1892			0.0	
1893			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1894			0.0	
1895			0.0	
1896			0.0	
1897			0.0	
1898			0.0	
1899			0.0	
1900			0.0	
1901	(35)	AUTO-PILOT SETTINGS	0.0	
1902			0.0	
1903			0.0	
1904			0.0	
1905			0.0	
1906			0.0	
1907			0.0	
1908			0.0	
1909			0.0	
1910			0.0	
1911			0.0	
1912			0.0	
1913			0.0	
1914			0.0	
1915			0.0	
1916			0.0	
1917			0.0	
1918			0.0	
1919			0.0	
1920			0.0	
1921			0.0	
1922			0.0	
1923			0.0	
1924			0.0	
1925			0.0	
1926			0.0	
1927			0.0	
1928			0.0	
1929			0.0	
1930			0.0	
1931			0.0	
1932			0.0	
1933			0.0	
1934			0.0	
1935			0.0	
1936	HPSET	SET HORSEPOWER IN AUTOPILOT	0.0	
1937	OPEN (2)		0.0	
1938			0.0	
1939	TMAUTO	TIME TO START AUTO-PILOT SIM.	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
1940	NPT	NO. OF AUTOPILOT TIME POINTS	0.0	
1941	T (20)	AUTO-PILOT TIME TABLE	0.0	SEC
1942			0.0	SEC
1943			0.0	SEC
1944			0.0	SEC
1945			0.0	SEC
1946			0.0	SEC
1947			0.0	SEC
1948			0.0	SEC
1949			0.0	SEC
1950			0.0	SEC
1951			0.0	SEC
1952			0.0	SEC
1953			0.0	SEC
1954			0.0	SEC
1955			0.0	SEC
1956			0.0	SEC
1957			0.0	SEC
1958			0.0	SEC
1959			0.0	SEC
1960			0.0	SEC
1961	E (20)	AUTO-PILOT VEL. TABLE	0.0	FT/SEC
1962			0.0	FT/SEC
1963			0.0	FT/SEC
1964			0.0	FT/SEC
1965			0.0	FT/SEC
1966			0.0	FT/SEC
1967			0.0	FT/SEC
1968			0.0	FT/SEC
1969			0.0	FT/SEC
1970			0.0	FT/SEC
1971			0.0	FT/SEC
1972			0.0	FT/SEC
1973			0.0	FT/SEC
1974			0.0	FT/SEC
1975			0.0	FT/SEC
1976			0.0	FT/SEC
1977			0.0	FT/SEC
1978			0.0	FT/SEC
1979			0.0	FT/SEC
1980			0.0	FT/SEC
1981	GAINT (20)	TRIM GAIN,PROP BL ANG (+) OR ANG OF ATTACK (-) RAD/FT/S	-1.6000E-03	
1982		TRIM GAIN,BANK ANG (+) RAD/F/S	3.0000E-02	
1983		TRIM GAIN,COLLECT. ANG (-) OR ANG OF ATTACK (-) RAD/FT/S	-1.6000E-03	
1984		TRIM GAIN,LAT. CYCLIC(A1S) +	1.0000E-02	SEC

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION		SAMPLE VALUE	UNITS
1985		TRIM GAIN,LONG CYCLIC(B1S)	-	-3.0000E-02	SEC
1986		TRIM GAIN,TAIL ROTOR COLL	-	-7.5000E-02	SEC
1987		TRIM GAIN,SWP ROLL MOM	+	0.0	F-LB/R/S
1988		TRIM GAIN,SWP VERT DISP	-	0.0	SEC
1989		TRIM GAIN,ENG. TORQUE	+	0.0	F-LB/R/S
1990		TRIM GAIN,FLT PATH ANG RAD/FT/S	-	0.0	
1991		TRIM GAIN,COLL. AUTOROTATION	+	0.0	SEC
1992		TRIM GAIN,COLL (RAD/S)/(FT-LB)	+	0.0	
1993				0.0	
1994		TRIM GAIN,SWP PITCH MOM	+	0.0	F-LB/R/S
1995				0.0	F-LB/R/S
1996				0.0	F-LB/R/S
1997				0.0	F-LB/R/S
1998				0.0	F-LB/R/S
1999				0.0	F-LB/R/S
2000	TRMUPD	TRIM UPDATE FLAG 0=OFF,1=ON		0.0	
2001	THTORS(40,4)	TRIM SAVE DATA BLADE TORSION DISPLACEMENT		0.0	RAD
2002				0.0	RAD
2003				0.0	RAD
2004				0.0	RAD
2005				0.0	RAD
2006				0.0	RAD
2007				0.0	RAD
2008				0.0	RAD
2009				0.0	RAD
2010				0.0	RAD
2011				0.0	RAD
2012				0.0	RAD
2013				0.0	RAD
2014				0.0	RAD
2015				0.0	RAD
2016				0.0	RAD
2017				0.0	RAD
2018				0.0	RAD
2019				0.0	RAD
2020				0.0	RAD
2021				0.0	RAD
2022				0.0	RAD
2023				0.0	RAD
2024				0.0	RAD
2025				0.0	RAD
2026				0.0	RAD
2027				0.0	RAD
2028				0.0	RAD

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2029			0.0	RAD
2030			0.0	RAD
2031			0.0	RAD
2032			0.0	RAD
2033			0.0	RAD
2034			0.0	RAD
2035			0.0	RAD
2036			0.0	RAD
2037			0.0	RAD
2038			0.0	RAD
2039			0.0	RAD
2040			0.0	RAD
2041			0.0	RAD
2042			0.0	RAD
2043			0.0	RAD
2044			0.0	RAD
2045			0.0	RAD
2046			0.0	RAD
2047			0.0	RAD
2048			0.0	RAD
2049			0.0	RAD
2050			0.0	RAD
2051			0.0	RAD
2052			0.0	RAD
2053			0.0	RAD
2054			0.0	RAD
2055			0.0	RAD
2056			0.0	RAD
2057			0.0	RAD
2058			0.0	RAD
2059			0.0	RAD
2060			0.0	RAD
2061			0.0	RAD
2062			0.0	RAD
2063			0.0	RAD
2064			0.0	RAD
2065			0.0	RAD
2066			0.0	RAD
2067			0.0	RAD
2068			0.0	RAD
2069			0.0	RAD
2070			0.0	RAD
2071			0.0	RAD
2072			0.0	RAD
2073			0.0	RAD
2074			0.0	RAD
2075			0.0	RAD
2076			0.0	RAD
2077			0.0	RAD
2078			0.0	RAD

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2079			0.0	RAD
2080			0.0	RAD
2081			0.0	RAD
2082			0.0	RAD
2083			0.0	RAD
2084			0.0	RAD
2085			0.0	RAD
2086			0.0	RAD
2087			0.0	RAD
2088			0.0	RAD
2089			0.0	RAD
2090			0.0	RAD
2091			0.0	RAD
2092			0.0	RAD
2093			0.0	RAD
2094			0.0	RAD
2095			0.0	RAD
2096			0.0	RAD
2097			0.0	RAD
2098			0.0	RAD
2099			0.0	RAD
2100			0.0	RAD
2101			0.0	RAD
2102			0.0	RAD
2103			0.0	RAD
2104			0.0	RAD
2105			0.0	RAD
2106			0.0	RAD
2107			0.0	RAD
2108			0.0	RAD
2109			0.0	RAD
2110			0.0	RAD
2111			0.0	RAD
2112			0.0	RAD
2113			0.0	RAD
2114			0.0	RAD
2115			0.0	RAD
2116			0.0	RAD
2117			0.0	RAD
2118			0.0	RAD
2119			0.0	RAD
2120			0.0	RAD
2121			0.0	RAD
2122			0.0	RAD
2123			0.0	RAD
2124			0.0	RAD
2125			0.0	RAD
2126			0.0	RAD
2127			0.0	RAD
2128			0.0	RAD

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2129			0.0	RAD
2130			0.0	RAD
2131			0.0	RAD
2132			0.0	RAD
2133			0.0	RAD
2134			0.0	RAD
2135			0.0	RAD
2136			0.0	RAD
2137			0.0	RAD
2138			0.0	RAD
2139			0.0	RAD
2140			0.0	RAD
2141			0.0	RAD
2142			0.0	RAD
2143			0.0	RAD
2144			0.0	RAD
2145			0.0	RAD
2146			0.0	RAD
2147			0.0	RAD
2148			0.0	RAD
2149			0.0	RAD
2150			0.0	RAD
2151			0.0	RAD
2152			0.0	RAD
2153			0.0	RAD
2154			0.0	RAD
2155			0.0	RAD
2156			0.0	RAD
2157			0.0	RAD
2158			0.0	RAD
2159			0.0	RAD
2160			0.0	RAD
2161	THTRD (40,4)	TRIM SAVE DATA BLADE TORSION VELOCITY	0.0	RAD/SEC
2162			0.0	RAD/SEC
2163			0.0	RAD/SEC
2164			0.0	RAD/SEC
2165			0.0	RAD/SEC
2166			0.0	RAD/SEC
2167			0.0	RAD/SEC
2168			0.0	RAD/SEC
2169			0.0	RAD/SEC
2170			0.0	RAD/SEC
2171			0.0	RAD/SEC
2172			0.0	RAD/SEC
2173			0.0	RAD/SEC
2174			0.0	RAD/SEC
2175			0.0	RAD/SEC
2176			0.0	RAD/SEC

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2177			0.0	RAD/SEC
2178			0.0	RAD/SEC
2179			0.0	RAD/SEC
2180			0.0	RAD/SEC
2181			0.0	RAD/SEC
2182			0.0	RAD/SEC
2183			0.0	RAD/SEC
2184			0.0	RAD/SEC
2185			0.0	RAD/SEC
2186			0.0	RAD/SEC
2187			0.0	RAD/SEC
2188			0.0	RAD/SEC
2189			0.0	RAD/SEC
2190			0.0	RAD/SEC
2191			0.0	RAD/SEC
2192			0.0	RAD/SEC
2193			0.0	RAD/SEC
2194			0.0	RAD/SEC
2195			0.0	RAD/SEC
2196			0.0	RAD/SEC
2197			0.0	RAD/SEC
2198			0.0	RAD/SEC
2199			0.0	RAD/SEC
2200			0.0	RAD/SEC
2201			0.0	RAD/SEC
2202			0.0	RAD/SEC
2203			0.0	RAD/SEC
2204			0.0	RAD/SEC
2205			0.0	RAD/SEC
2206			0.0	RAD/SEC
2207			0.0	RAD/SEC
2208			0.0	RAD/SEC
2209			0.0	RAD/SEC
2210			0.0	RAD/SEC
2211			0.0	RAD/SEC
2212			0.0	RAD/SEC
2213			0.0	RAD/SEC
2214			0.0	RAD/SEC
2215			0.0	RAD/SEC
2216			0.0	RAD/SEC
2217			0.0	RAD/SEC
2218			0.0	RAD/SEC
2219			0.0	RAD/SEC
2220			0.0	RAD/SEC
2221			0.0	RAD/SEC
2222			0.0	RAD/SEC
2223			0.0	RAD/SEC
2224			0.0	RAD/SEC
2225			0.0	RAD/SEC
2226			0.0	RAD/SEC

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2227			0.0	RAD/SEC
2228			0.0	RAD/SEC
2229			0.0	RAD/SEC
2230			0.0	RAD/SEC
2231			0.0	RAD/SEC
2232			0.0	RAD/SEC
2233			0.0	RAD/SEC
2234			0.0	RAD/SEC
2235			0.0	RAD/SEC
2236			0.0	RAD/SEC
2237			0.0	RAD/SEC
2238			0.0	RAD/SEC
2239			0.0	RAD/SEC
2240			0.0	RAD/SEC
2241			0.0	RAD/SEC
2242			0.0	RAD/SEC
2243			0.0	RAD/SEC
2244			0.0	RAD/SEC
2245			0.0	RAD/SEC
2246			0.0	RAD/SEC
2247			0.0	RAD/SEC
2248			0.0	RAD/SEC
2249			0.0	RAD/SEC
2250			0.0	RAD/SEC
2251			0.0	RAD/SEC
2252			0.0	RAD/SEC
2253			0.0	RAD/SEC
2254			0.0	RAD/SEC
2255			0.0	RAD/SEC
2256			0.0	RAD/SEC
2257			0.0	RAD/SEC
2258			0.0	RAD/SEC
2259			0.0	RAD/SEC
2260			0.0	RAD/SEC
2261			0.0	RAD/SEC
2262			0.0	RAD/SEC
2263			0.0	RAD/SEC
2264			0.0	RAD/SEC
2265			0.0	RAD/SEC
2266			0.0	RAD/SEC
2267			0.0	RAD/SEC
2268			0.0	RAD/SEC
2269			0.0	RAD/SEC
2270			0.0	RAD/SEC
2271			0.0	RAD/SEC
2272			0.0	RAD/SEC
2273			0.0	RAD/SEC
2274			0.0	RAD/SEC
2275			0.0	RAD/SEC
2276			0.0	RAD/SEC

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL		DESCRIPTION	SAMPLE VALUE	UNITS
				0.0	RAD/SEC
2277				0.0	RAD/SEC
2278				0.0	RAD/SEC
2279				0.0	RAD/SEC
2280				0.0	RAD/SEC
2281				0.0	RAD/SEC
2282				0.0	RAD/SEC
2283				0.0	RAD/SEC
2284				0.0	RAD/SEC
2285				0.0	RAD/SEC
2286				0.0	RAD/SEC
2287				0.0	RAD/SEC
2288				0.0	RAD/SEC
2289				0.0	RAD/SEC
2290				0.0	RAD/SEC
2291				0.0	RAD/SEC
2292				0.0	RAD/SEC
2293				0.0	RAD/SEC
2294				0.0	RAD/SEC
2295				0.0	RAD/SEC
2296				0.0	RAD/SEC
2297				0.0	RAD/SEC
2298				0.0	RAD/SEC
2299				0.0	RAD/SEC
2300				0.0	RAD/SEC
2301				0.0	RAD/SEC
2302				0.0	RAD/SEC
2303				0.0	RAD/SEC
2304				0.0	RAD/SEC
2305				0.0	RAD/SEC
2306				0.0	RAD/SEC
2307				0.0	RAD/SEC
2308				0.0	RAD/SEC
2309				0.0	RAD/SEC
2310				0.0	RAD/SEC
2311				0.0	RAD/SEC
2312				0.0	RAD/SEC
2313				0.0	RAD/SEC
2314				0.0	RAD/SEC
2315				0.0	RAD/SEC
2316				0.0	RAD/SEC
2317				0.0	RAD/SEC
2318				0.0	RAD/SEC
2319				0.0	RAD/SEC
2320					
				0.0	
2321	THG1	(40,4)	TRIM SAVE DATA BLADE TORSION ACCELERATION		
				0.0	
2322				0.0	
2323				0.0	
2324					

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2325			0.0	
2326			0.0	
2327			0.0	
2328			0.0	
2329			0.0	
2330			0.0	
2331			0.0	
2332			0.0	
2333			0.0	
2334			0.0	
2335			0.0	
2336			0.0	
2337			0.0	
2338			0.0	
2339			0.0	
2340			0.0	
2341			0.0	
2342			0.0	
2343			0.0	
2344			0.0	
2345			0.0	
2346			0.0	
2347			0.0	
2348			0.0	
2349			0.0	
2350			0.0	
2351			0.0	
2352			0.0	
2353			0.0	
2354			0.0	
2355			0.0	
2356			0.0	
2357			0.0	
2358			0.0	
2359			0.0	
2360			0.0	
2361			0.0	
2362			0.0	
2363			0.0	
2364			0.0	
2365			0.0	
2366			0.0	
2367			0.0	
2368			0.0	
2369			0.0	
2370			0.0	
2371			0.0	
2372			0.0	
2373			0.0	
2374			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2375			0.0	
2376			0.0	
2377			0.0	
2378			0.0	
2379			0.0	
2380			0.0	
2381			0.0	
2382			0.0	
2383			0.0	
2384			0.0	
2385			0.0	
2386			0.0	
2387			0.0	
2388			0.0	
2389			0.0	
2390			0.0	
2391			0.0	
2392			0.0	
2393			0.0	
2394			0.0	
2395			0.0	
2396			0.0	
2397			0.0	
2398			0.0	
2399			0.0	
2400			0.0	
2401			0.0	
2402			0.0	
2403			0.0	
2404			0.0	
2405			0.0	
2406			0.0	
2407			0.0	
2408			0.0	
2409			0.0	
2410			0.0	
2411			0.0	
2412			0.0	
2413			0.0	
2414			0.0	
2415			0.0	
2416			0.0	
2417			0.0	
2418			0.0	
2419			0.0	
2420			0.0	
2421			0.0	
2422			0.0	
2423			0.0	
2424			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2425			0.0	
2426			0.0	
2427			0.0	
2428			0.0	
2429			0.0	
2430			0.0	
2431			0.0	
2432			0.0	
2433			0.0	
2434			0.0	
2435			0.0	
2436			0.0	
2437			0.0	
2438			0.0	
2439			0.0	
2440			0.0	
2441			0.0	
2442			0.0	
2443			0.0	
2444			0.0	
2445			0.0	
2446			0.0	
2447			0.0	
2448			0.0	
2449			0.0	
2450			0.0	
2451			0.0	
2452			0.0	
2453			0.0	
2454			0.0	
2455			0.0	
2456			0.0	
2457			0.0	
2458			0.0	
2459			0.0	
2460			0.0	
2461			0.0	
2462			0.0	
2463			0.0	
2464			0.0	
2465			0.0	
2466			0.0	
2467			0.0	
2468			0.0	
2469			0.0	
2470			0.0	
2471			0.0	
2472			0.0	
2473			0.0	
2474			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2475			0.0	
2476			0.0	
2477			0.0	
2478			0.0	
2479			0.0	
2480			0.0	
2481	OPEN (11)		0.0	
2482			0.0	
2483			0.0	
2484			0.0	
2485			0.0	
2486			0.0	
2487			0.0	
2488			0.0	
2489			0.0	
2490			0.0	
2491			0.0	
2492	LFB	PRE-LOAD FEEDBACK SPRING DEFLECTION +TENSION	0.0	FT
2493	OPEN (21)		0.0	
2494			0.0	
2495			0.0	
2496			0.0	
2497			0.0	
2498			0.0	
2499			0.0	
2500			0.0	
2501			0.0	
2502			0.0	
2503			0.0	
2504			0.0	
2505			0.0	
2506			0.0	
2507			0.0	
2508			0.0	
2509			0.0	
2510			0.0	
2511			0.0	
2512			0.0	
2513			0.0	
2514	XSTDIF	FEEDBACK ARM SPANWISE LENGTH	0.0	FT
2515	FLAP2	2ND FLAP MODE REMOVAL FLAG 1=REMOVE	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2516	PSIFB	GYRO FEEDBACK PHASE ANGLE + LAGS BLADE	0.0	RAD
2517	OPEN (5)		0.0	
2518			0.0	
2519			0.0	
2520			0.0	
2521			0.0	
2522	ZRMI (3)	OUTPLANE DISPL OF FDBK MOUNT BLADE MODE 1 + DN	-3.8620E-02	
2523		BLADE MODE 2	1.8100E-02	
2524		BLADE MODE 3	-3.6810E-02	
2525	OPEN (3)		0.0	
2526			0.0	
2527			0.0	
2528	ZRMPI (3)	OUTPLANE SLOPE OF FDBK MOUNT BLADE MODE 1 + DN	-7.6960E-02	
2529		BLADE MODE 2	3.6210E-02	
2530		BLADE MODE 3	-7.3610E-02	
2531	OPEN (14)		0.0	
2532			0.0	
2533			0.0	
2534			0.0	
2535			0.0	
2536			0.0	
2537			0.0	
2538			0.0	
2539			0.0	
2540			0.0	
2541			0.0	
2542			0.0	
2543			0.0	
2544			0.0	
2545	KFBG	GYRO FEEDBACK SPRING	0.0	LB/FT
2546	ZJLIM	GYRO FEEDBACK ARM SLOP TRAVEL	0.0	FT
2547	RFB	GYRO FEEDBACK ARM RADIUS	0.0	FT
2548	OPEN		0.0	
2549	DPHIS	SHAFT ROLL TILT DAMPING	0.0	F-LB/R/S
2550	DTHTS	SHAFT PITCH TILT DAMPING	0.0	F-LB/R/S

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2551	PSLOPL	SWP SLOP LIMIT ON PHI	0.0	RAD
2552	TSLOPL	SWP SLOP LIMIT ON THETA	0.0	RAD
2553	TCUTO	NO. OF ADDITIONAL CYCLES OF 4 BLADE TRIM IF RA(440)=3	0.0	
2554	TCUT3	NO. OF ADDITIONAL CYCLES OF 1 BLADE TRIM IF RA(440)=1	0.0	
2555	ISTALL	DYNAMIC STALL SIMULATION FLAG 1=STALL SIM.	0.0	
2556	OPEN (3)		0.0	
2557			0.0	
2558			0.0	
2559	FACTM	FACTOR USED IN CM CALC DURING DYNAMIC STALL SIM.	0.0	
2560	IHA	NO. OF HARMONICS+1 TO USE FOR HARMONIC TRIM OPTION	0.0	
2561	QMCON (6)	HARMONIC TRIM DATA	0.0	
2562			0.0	
2563			0.0	
2564			0.0	
2565			0.0	
2566			0.0	
2567	OPEN (3)		0.0	
2568			0.0	
2569			0.0	
2570	STA70	STATION WHERE SWEEP AND DROOP BEGIN	0.0	FT
2571	GAIN1 (19)	SINGLE BLADE TRIM GAIN-BP	0.0	
2572		SINGLE BLADE TRIM GAIN-PHI	0.0	
2573		SINGLE BLADE TRIM GAIN-THO OR ALPHA	0.0	
2574		SINGLE BLADE TRIM GAIN-A1S	0.0	
2575		SINGLE BLADE TRIM GAIN-B1S	0.0	
2576		SINGLE BLADE TRIM GAIN-THOTR	0.0	
2577		SINGLE BLADE TRIM GAIN-GLCON AND GMCON	0.0	
2578			0.0	
2579			0.0	
2580			0.0	
2581			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL		DESCRIPTION	SAMPLE VALUE	UNITS
2582				0.0	
2583				0.0	
2584				0.0	
2585				0.0	
2586				0.0	
2587				0.0	
2588				0.0	
2589				0.0	
2590	OPEN	(11)		0.0	
2591				0.0	
2592				0.0	
2593				0.0	
2594				0.0	
2595				0.0	
2596				0.0	
2597				0.0	
2598				0.0	
2599				0.0	
2600				0.0	
2601	ALFA	(20)	AIRFRAME AERO COEFF. TABLE ANGLE OF ATTACK	-1.8000E 02	DEG
2602				1.8000E 02	DEG
2603				0.0	DEG
2604				0.0	DEG
2605				0.0	DEG
2606				0.0	DEG
2607				0.0	DEG
2608				0.0	DEG
2609				0.0	DEG
2610				0.0	DEG
2611				0.0	DEG
2612				0.0	DEG
2613				0.0	DEG
2614				0.0	DEG
2615				0.0	DEG
2616				0.0	DEG
2617				0.0	DEG
2618				0.0	DEG
2619				0.0	DEG
2620				0.0	DEG
2621	CL	(20)	AIRFRAME CL TABLE	0.0	
2622				0.0	
2623				0.0	
2624				0.0	
2625				0.0	
2626				0.0	
2627				0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2628			0.0	
2629			0.0	
2630			0.0	
2631			0.0	
2632			0.0	
2633			0.0	
2634			0.0	
2635			0.0	
2636			0.0	
2637			0.0	
2638			0.0	
2639			0.0	
2640			0.0	
2641	CM (20)	AIRFRAME CM TABLE	0.0	
2642			0.0	
2643			0.0	
2644			0.0	
2645			0.0	
2646			0.0	
2647			0.0	
2648			0.0	
2649			0.0	
2650			0.0	
2651			0.0	
2652			0.0	
2653			0.0	
2654			0.0	
2655			0.0	
2656			0.0	
2657			0.0	
2658			0.0	
2659			0.0	
2660			0.0	
2661	CD (20)	AIRFRAME CD TABLE	3.6500E 01	
2662			3.6500E 01	
2663			0.0	
2664			0.0	
2665			0.0	
2666			0.0	
2667			0.0	
2668			0.0	
2669			0.0	
2670			0.0	
2671			0.0	
2672			0.0	
2673			0.0	
2674			0.0	
2675			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2676			0.0	
2677			0.0	
2678			0.0	
2679			0.0	
2680			0.0	
2681	AWING	WING AREA	1.0000E 00	FT2
2682	CWING	WING CORD	1.0000E 00	FT
2683	AOTR	TAIL ROTOR BLADE AREA	1.1400E 01	FT2
2684	RTR	TAIL ROTOR RADIUS	4.6700E 00	FT
2685	A	TAIL ROTOR DCL/DALPHA	5.7300E 00	1/RAD
2686	B	TAIL ROTOR TIP LOSS FACTOR	9.7000E-01	
2687	OPEN		0.0	
2688	CUTOUT	MAIN ROTOR BLADE AERO CUTOUT	4.5000E 00	FT
2689	ILOOK	AERO TABLE FLAG, 0= FAST AERO 1 = SEVEN TABLE LOOKUP	1.0000E 00	
2690	IFOIL	CM TABLE FLAG 0=23008 TABLE 1=0012 TABLE	1.0000E 00	
2691	XNTAB (5)	NORMALIZED BLADE LOCATION	0.0	
2692			1.0000E 00	
2693			0.0	
2694			0.0	
2695			0.0	
2696	TCTAB (5)	THICKNESS RATIO	1.2000E-01	
2697			1.2000E-01	
2698			0.0	
2699			0.0	
2700			0.0	
2701	CLTAB (5)	DESIGN LIFT COEFFICIENT	0.0	
2702			0.0	
2703			0.0	
2704			0.0	
2705			0.0	
2706	OPEN (95)		0.0	
2707			0.0	
2708			0.0	
2709			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2710			0.0	
2711			0.0	
2712			0.0	
2713			0.0	
2714			0.0	
2715			0.0	
2716			0.0	
2717			0.0	
2718			0.0	
2719			0.0	
2720			0.0	
2721			0.0	
2722			0.0	
2723			0.0	
2724			0.0	
2725			0.0	
2726			0.0	
2727			0.0	
2728			0.0	
2729			0.0	
2730			0.0	
2731			0.0	
2732			0.0	
2733			0.0	
2734			0.0	
2735			0.0	
2736			0.0	
2737			0.0	
2738			0.0	
2739			0.0	
2740			0.0	
2741			0.0	
2742			0.0	
2743			0.0	
2744			0.0	
2745			0.0	
2746			0.0	
2747			0.0	
2748			0.0	
2749			0.0	
2750			0.0	
2751			0.0	
2752			0.0	
2753			0.0	
2754			0.0	
2755			0.0	
2756			0.0	
2757			0.0	
2758			0.0	
2759			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL		DESCRIPTION	SAMPLE VALUE	UNITS
2760				0.0	
2761				0.0	
2762				0.0	
2763				0.0	
2764				0.0	
2765				0.0	
2766				0.0	
2767				0.0	
2768				0.0	
2769				0.0	
2770				0.0	
2771				0.0	
2772				0.0	
2773				0.0	
2774				0.0	
2775				0.0	
2776				0.0	
2777				0.0	
2778				0.0	
2779				0.0	
2780				0.0	
2781				0.0	
2782				0.0	
2783				0.0	
2784				0.0	
2785				0.0	
2786				0.0	
2787				0.0	
2788				0.0	
2789				0.0	
2790				0.0	
2791				0.0	
2792				0.0	
2793				0.0	
2794				0.0	
2795				0.0	
2796				0.0	
2797				0.0	
2798				0.0	
2799				0.0	
2800				0.0	
2801	DPF	(4)	PSEUDO PITCH HORN SAVE DATA DISPLACEMENT	0.0	
2802				0.0	
2803				0.0	
2804				0.0	
2805	DPFD	(4)	PSEUDO PITCH HORN SAVE DATA VELOCITY	0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2806			0.0	
2807			0.0	
2808			0.0	
2809	DPF1 (4)	PSEUDO PITCH HORN SAVE DATA DISPL. BACK VALUES	0.0	
2810			0.0	
2811			0.0	
2812			0.0	
2813	DPF2 (4)	PSEUDO PITCH HORN SAVE DATA DISPL. BACK VALUES	0.0	
2814			0.0	
2815			0.0	
2816			0.0	
2817	OPEN (14)		0.0	
2818			0.0	
2819			0.0	
2820			0.0	
2821			0.0	
2822			0.0	
2823			0.0	
2824			0.0	
2825			0.0	
2826			0.0	
2827			0.0	
2828			0.0	
2829			0.0	
2830			0.0	
2831	TPART (6,6)	SENSITIVITY MATRIX REQUIRED FOR SINGLE BLADE TRIM	0.0	
2832			0.0	
2833			0.0	
2834			0.0	
2835			0.0	
2836			0.0	
2837			0.0	
2838			0.0	
2839			0.0	
2840			0.0	
2841			0.0	
2842			0.0	
2843			0.0	
2844			0.0	
2845			0.0	
2846			0.0	
2847			0.0	
2848			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2849			0.0	
2850			0.0	
2851			0.0	
2852			0.0	
2853			0.0	
2854			0.0	
2855			0.0	
2856			0.0	
2857			0.0	
2858			0.0	
2859			0.0	
2860			0.0	
2861			0.0	
2862			0.0	
2863			0.0	
2864			0.0	
2865			0.0	
2866			0.0	
2867	OPEN (3)		0.0	
2868			0.0	
2869			0.0	
2870	IDYN	DYNAMIC TORSION SIMULATION FLAG. 1=ON	0.0	
2871	PPTOR (20)	DYNAMIC TORSION MODE SHAPE	0.0	
2872			0.0	
2873			0.0	
2874			0.0	
2875			0.0	
2876			0.0	
2877			0.0	
2878			0.0	
2879			0.0	
2880			0.0	
2881			0.0	
2882			0.0	
2883			0.0	
2884			0.0	
2885			0.0	
2886			0.0	
2887			0.0	
2888			0.0	
2889			0.0	
2890			0.0	
2891	OPEN (110)		0.0	
2892			0.0	
2893			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2894			0.0	
2895			0.0	
2896			0.0	
2897			0.0	
2898			0.0	
2899			0.0	
2900			0.0	
2901			0.0	
2902			0.0	
2903			0.0	
2904			0.0	
2905			0.0	
2906			0.0	
2907			0.0	
2908			0.0	
2909			0.0	
2910			0.0	
2911			0.0	
2912			0.0	
2913			0.0	
2914			0.0	
2915			0.0	
2916			0.0	
2917			0.0	
2918			0.0	
2919			0.0	
2920			0.0	
2921			0.0	
2922			0.0	
2923			0.0	
2924			0.0	
2925			0.0	
2926			0.0	
2927			0.0	
2928			0.0	
2929			0.0	
2930			0.0	
2931			0.0	
2932			0.0	
2933			0.0	
2934			0.0	
2935			0.0	
2936			0.0	
2937			0.0	
2938			0.0	
2939			0.0	
2940			0.0	
2941			0.0	
2942			0.0	
2943			0.0	

TABLE 3-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2944			0.0	
2945			0.0	
2946			0.0	
2947			0.0	
2948			0.0	
2949			0.0	
2950			0.0	
2951			0.0	
2952			0.0	
2953			0.0	
2954			0.0	
2955			0.0	
2956			0.0	
2957			0.0	
2958			0.0	
2959			0.0	
2960			0.0	
2961			0.0	
2962			0.0	
2963			0.0	
2964			0.0	
2965			0.0	
2966			0.0	
2967			0.0	
2968			0.0	
2969			0.0	
2970			0.0	
2971			0.0	
2972			0.0	
2973			0.0	
2974			0.0	
2975			0.0	
2976			0.0	
2977			0.0	
2978			0.0	
2979			0.0	
2980			0.0	
2981			0.0	
2982			0.0	
2983			0.0	
2984			0.0	
2985			0.0	
2986			0.0	
2987			0.0	
2988			0.0	
2989			0.0	
2990			0.0	
2991			0.0	
2992			0.0	
2993			0.0	

TABLE 5-1 - Continued

INPUT DATA/RELATIVE ADDRESS TABLE

R/A	PROGRAM SYMBOL	DESCRIPTION	SAMPLE VALUE	UNITS
2994			0.0	
2995			0.0	
2996			0.0	
2997			0.0	
2998			0.0	
2999			0.0	
3000			0.0	

TABLE 3-2. RELATIVE ADDRESS REVERSE DIRECTORY

A	2685	CUTOUT	2688	GFDDL	354	IZZF	1463
AKPH	1478	CWING	2682	GFDDM	358	IZZG	118
ALFA	2601	CYCFLG	134	GFKDL	359	IZZGNR	360
ALPHA	58	CZERO	1252	GFKDM	357	IZZGR	350
ADTR	2683	C1F1	146	GINT	61	IZZH	1468
APHI	664	C1I1	145	GKSTOP	1277	KFBG	2545
APSI	666	C2F1	146	GLCN	661	KFPHG	395
ATC	670	DCMR	1256	GLCON	69	KPH	1487
ATH	668	DCMR1	1347	GMASS	139	KPHCON	376
AWING	2681	DCOEF	1341	GMCN	662	KSTART	500
AZT	32	DELCD	1264	GMCON	70	KTHCON	377
AIS	54	DELTO	112	GRD	363	KTI	1345
AITR	77	DELT2	113	GRENG	1474	KTO	1346
B	2686	DELZOB	1479	GRK	362	KXCS	585
BET	38	DEODA	135	GRPRD	1473	KXPR	587
BETA	1266	DGDHG	1263	GRTR	1475	KYCS	586
BETAG	125	DOEO	271	GSDL	353	K1PRM	593
BFAS	1270	DOE1	272	GSDM	356	K2PRM	594
BI	1301	DPF	2801	GSKL	352	LFB	2492
BLADK	1241	DPFD	2805	GSKM	355	MUB	347
BMS1F	921	DPF1	2809	H,-ZF	93	NAZ	51
BMS1F	961	DPF2	2813	HARDSP	42	NGDRF	133
BMS1F	1001	DPHIS	2549	HF	96	NINC	499
BMS1F	1041	DSDGJ	1361	HMASS	366	NMP	150
BMS1I	761	DSTAF	297	HPSET	1936	NMPAT	680
BMS1I	801	DTHTS	2550	HTR	1348	NPT	1940
BMS1I	841	DTH1	1402	HUBL	128	NRAD	498
BMS1I	881	DTH2	1403	HVS	103	NSDATA	44
BMS2F	1081	DVEQ1	582	IAMCS	490	NVAR1	299
BMS2F	1121	DVEQ2	584	IBLADE	1300	NVAR2	300
BMS2F	1161	E	1961	ICONTR	46	NVEC1	301
BMS2F	1201	E	136	IDECUP	1499	NVEC2	1801
BP	53	EDIT	104	IDYN	2870	U	52
BPHI	665	ENDMZZ	92	IFFT	1483	OB	82
BPSI	667	ENGHPX	1484	IFLEX	399	PARCON	1352
BTH	669	ETAE	106	IFOIL	2690	PBP	251
BIS	55	FACTM	2559	IHA	2560	PHI	59
CAPHIS	396	FAST	440	IHAFLG	1257	PHIREF	1269
CASF	50	FBL1F	279	IHAPLT	1262	PIMR	66
CD	2661	FBL1I	275	ILOOK	2689	PIMRD	72
CFB	1485	FBL2F	283	IPHORN	1480	PIMRN1	75
CFLY	1251	FCF	114	IPITCH	90	PPTOR	2871
CHI	119	FCG	116	IPLOT	48	PQENG	591
CHIG	345	FIDDLE	1494	IPRINT	49	PQEOM	592
CL	2621	FKS	375	IPUNCH	47	PRI	295
CLAG	371	FKSPT	273	ISTALL	2555	PSIFB	2516
CLTAB	2701	FLAP2	2515	IXXENG	1471	PSIFBL	397
CM	2641	FMASS	91	IXXF	1461	PSIPG	344
CONK	1253	FMN	441	IXXG	361	PSITE	641
COPAF	142	FX	1751	IXXPRO	1470	PSLOPL	2551
COFD	110	GAINT	1981	IXYF	1464	PT	151
CPHDSP	378	GAIN1	2571	IXZF	1465	PTAUTO	681
CRSFG	45	GAMMA	1268	IYYF	1462	PTHUAT	741
CTHDSP	379	GAMMA	63	IYYTR	1472	PTHO	211
CTRIM	1250	GASTOP	1276	IYZF	1466	PTHOTR	231

TABLE 3-2 - Continued

PXCS	171	THRCON	1350	YPHIF	365
PXCSAT	701	THTURS	2001	YTR	274
PXPZ	348	THTRD	2161	ZBPH	1477
PYCS	191	THO	56	ZFBAR	374
PYCSAT	721	THOTR	57	ZGS	1469
PYPZ	349	TH1	85	ZG1	141
QCGZ	138	TMAUTC	1939	Z1V1	1412
QIMR	67	TNBODY	1776	Z1V2	1413
QIMRD	73	TURCON	1351	Z1V3	1414
QIMRN1	76	TORFLG	1497	ZJLIM	2546
QKGZ1	137	TPART	2831	ZJOG	1482
QKGZ2	140	TPH	1468	ZOV1	1418
QKXCS	123	TRIMC	33	ZOV2	1419
QKXCSG	342	TRMUPD	2000	ZOV3	1420
QKYCS	124	TSCLE	298	ZRMI	2522
QKYCSG	343	TSLOPL	2552	ZRMPI	2528
QM	541	TSTOP	1498	ZOBL	346
QMCON	2561	TTB	1501		
QRI	296	TTFLAG	1404		
R	81	TURNLF	143		
RFB	2547	TURNSN	144		
RFFL	396	TWTR	1279		
RHI	109	TXS	294		
RLF	115	VEQ1	581		
RLG	117	VEQ2	583		
RRK	1278	VT	62		
RTE	2684	WIMR	65		
RTWANG	1491	WIMRD	71		
SLPS	101	WIMRN1	74		
SLTF	98	WITR	78		
SLVS	102	XCPDL	437		
SMALLA	111	XCSMAX	31		
SNGELF	60	XCS1	588		
SS	1291	XCS2	589		
STA70	2570	XFBAR	372		
STF	97	XNTAB	2691		
SVEC	1851	XSTDIF	2514		
SX	501	XTHTF	364		
SY	601	Y	1661		
T	1941	YCPDL	438		
TAU	1267	YCS	1421		
TAU	[illegible]	YCSMAX	494		
TAUACT	551	YCS1	590		
TAUG	595	YD	1691		
TC	287	YDD	1721		
TCT	1401	YFBAR	373		
TCTAE	2696	Y1V1	1409		
TCTRA	1280	Y1V2	1410		
TCUT	36	Y1V3	1411		
TCUTO	2553	YJOG	1481		
TCUT3	2554	YNA	1521		
TCX	292	YOV1	1415		
TCY	293	YOV2	1416		
TFFTFF	663	YOV3	1417		
THG1	2321	YP	1349		

The program has two modes of operation: TRIM and FLY. In both cases the equations of motion are solved in the time domain. In TRIM the user specifies the flight condition by giving the trajectory velocity, the air density, the load factor, and other essential data. Only the blade degrees of freedom are integrated in TRIM. TRIM directly controls the main rotor collective, the main rotor cyclic angles, the tail rotor collective, the fuselage angle of attack and the bank angle (or whatever combination of trim variables are specified by the trim option), and adjusts their value until the trim criteria are satisfied. The vehicle is usually understood to be trimmed when the mean value of the accelerations of the degrees of freedom approach zero. Vibratory components of 1P, 2P, etc., are allowed in all the degrees of freedom. One exception is a trim option which does not trim out the longitudinal acceleration before FLY. TRIM could be conducted to any nonsteady flight condition, but the need has not arisen.

In FLY all the degrees of freedom can be operative. More typically some of the degrees of freedom involving high-frequency modes are locked out, especially shaft bending and dynamic torsion or dynamic pitch horn bending. The fixed shaft option is commonly used and allows only the blade modes and the swash-plate degrees of freedom to operate.

At times a Fast Fourier Transform Analysis is used to analyze the damping and frequency of transient rotor modes from their time histories. This analysis is conducted by a separate program that is not part of the REXOR package of subroutines. Rather it is one of a number of subsidiary programs such as the blade mode generator, the feather linkage program, etc., used in "job step" with REXOR. The documentation of these subsidiary programs is outside the scope of this report.

3.3.1 Case Identification

Case identification consists of a case number, and two title cards. The case number and titles will appear on the printed output for identification. The case number will also appear on every frame, along with the date, of the graphic output. See Table 3-3.

TABLE 3-3. CASE IDENTIFICATION

Input Quantity	Address
case number	50
60 characters	1
60 characters	16

3.3.2 Trim Initialization

A number of inputs must be initialized to start trim. Air data conditions required are given in Table 3-4.

TABLE 3-4. AIR DATA CONDITIONS

Input Quantity			Address
v_s	CS	speed of sound, ft/sec	1291
ρ	RHO	atmosphere density, slugs/ft^3	109
h	H	altitude, ft	93

The altitude input is required to define a ground effect function. This function can be ignored by setting the altitude to some large value such as 1000 ft. An input of zero is not acceptable.

Trajectory and body orientation must be initialized. The required parameters are presented in Table 3-5. Each azimuth, ψ_E, is assumed zero and not included in the problem. Pitch attitude, θ_E, will be computed in the program.

TABLE 3-5. TRIM INPUT PARAMETER

Input Quantity			Address
V_T	VT	True velocity, ft/sec	62
β_F	BET	Sideslip angle, rad, + RT	38
α_F	ALPHA	Angle of attack, rad, + N UP	58
γ_F	GAMMA	Flight path angle, rad, + climb	63
ϕ_E	PHI	Bank angle, rad, + RT	59
Ω_0	O	Main rotor speed, rad/sec	52

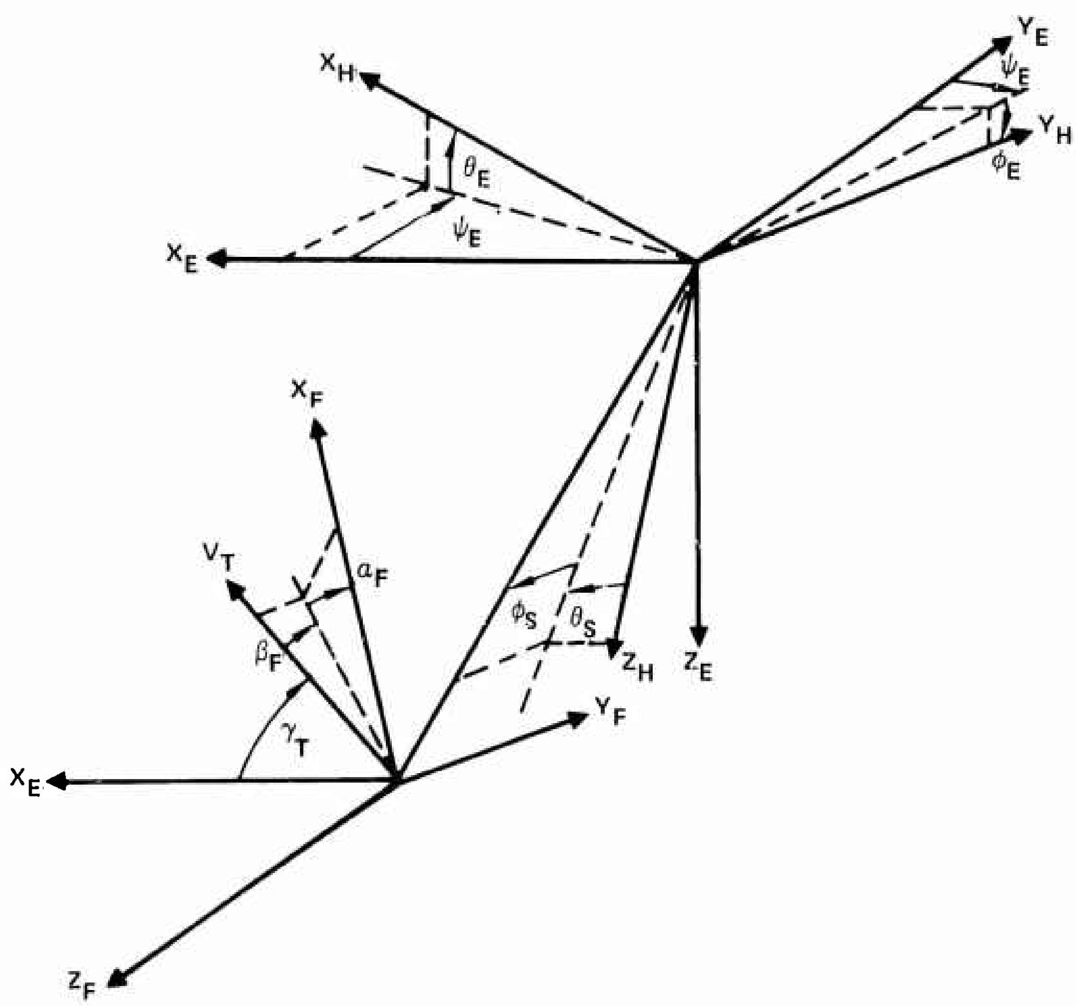


Figure 3-4. Wind-Earth-Hub Orientation

speed, V_T, and sideslip angle, β_F, will remain fixed as input but may vary during the fly computation. The other angles either remain fixed, or are initial conditions for the trim iteration procedure which is covered in Section 3.3.3.

The vehicle body rates are determined by the following equations during trim:

$$p = -\dot{\psi}_E \sin \theta_E \tag{3-1}$$

$$q = \dot{\psi}_E \cos \theta_E \sin \phi_E \tag{3-2}$$

$$r = \dot{\psi}_E \cos \theta_E \cos \phi_E \tag{3-3}$$

where the yaw velocity is determined by the relation

$$\dot{\psi}_E = \frac{g}{V_T} K (n^2 - 1)^{\frac{1}{2}} \tag{3-4}$$

n and K are inputs (Table 3-6) and determine $\dot{\psi}_E$.

TABLE 3-6. TURN INPUTS

Input Quantity			Address
n	TURNLF	TURN LOAD FACTOR	143
K	TURNSN	TURN DIRECTION INDICATOR. +1, RIGHT; -1, LEFT.	144

Normal inputs for the load factor and turn sign are

$$n = 1$$

and

$$K = 1,$$

giving unaccelerated flight.

For special studies it may be desirable to specify initial roll and pitch rates. The inputs of Table 3-7 are used for this purpose.

TABLE 3-7. INITIAL PITCH-ROLL DATA

Input Quantity			Address
p_0	PRI	Initial Roll Rate, rad/sec	295
q_0	QRI	Initial Pitch Rate, rad/sec	296

If either input is non zero, then:

$$p = p_0$$

$$q = q_0$$

Incremental rotor shaft moments may be specified via inputs. These are given in Table 3-8.

TABLE 3-8. INCREMENTAL SHAFT MOMENTS

Input Quantity		Address
TRIMQ(1)	Incremental Shaft Roll Mom., ft-lb, + RT.	33
TRIMQ(2)	Incremental Shaft Pitch Mom., ft-lb, +N. UP	34

Main rotor and tail rotor downwash functions are modeled in REXOR with lag equations of the form

$$w^{n+1} = e^{-dt/\tau} w^n + (1 - e^{-dt/\tau})\, f\,(w^n) \qquad (3\text{-}5)$$

These equations require time constants, τ. An initial set of values may be input to begin the process under favorable conditions. The downwash quantities and input addresses are given in Table 3-9. Tail rotor flapping dynamics are also modeled with a first-order lag, and the flapping angle is included in Table 3-9.

TABLE 3-9. INFLOW DATA			
Input Quantity			Address
WIMR	Vertical Downwash	+DN	65
PIMR	Roll Downwash	+RT	66
QIMR	Pitch Downwash	+N UP	67
WITR	Tail Rotor Downwash		78
AITR	Tail Rotor Longitudinal Flap Angle		77
NOTE: WIMR is a divisor on the program; therefore, some non-zero value must be used.			

Although initial values are not required, except for WIMR, good initial guesses may be helpful to the trim convergence speed.

The lag equation time constants for the above functions are required for both physical realism and program numerical stability. See Table 3-10.

TABLE 3-10. TIME LAG CONSTANTS		
Input Quantity		Address
TC(1)	τ for downwash functions during trim	287
TC(2)	τ for downwash functions during fly	288
TC(3)	τ for tail rotor flap angle function	289

3.3.3 Trim Operation

Three trim techniques have been programmed in REXOR. The first is characterized as a fully integrated trim in which all blades and corresponding modes are integrated. A second procedure, known as single blade trim, has been programmed. One blade, representing the rotor, is integrated around a rotor revolution. After each revolution the blades are analyzed for their collective and cyclic components and trim variables adjusted. This technique has sometimes resulted in a modest amount of savings in the time to trim. A third method known as harmonic trim is programmed but was never successfully employed. Although one blade trim has been used, the level of confidence in its adaptability to a variety of conditions is too low to warrant its documentation here. RA(44) = FAST = 0 gives the fully integrated trim technique. A number of inputs exist which are associated with the single blade and harmonic trim options. These addresses are listed in Table 3-11 for completeness.

TABLE 3-11. TRIM OPTIONS

Input Quantity	Address
FAST	440
TCUTO	2553
TCUT3	2554
IHA	2560
QMCON (6)	2561 - 2566
GAIN1 (19)	2571 - 2589
TPART (6,6)	2831 - 2866
DCOEF (4)	1341 - 1344

The fully integrated trim is then characterized as follows. All main rotor blade modes are integrated and allowed to reach steady-rate values unattended except for an initial period of artificial structural damping which is designed to speed up the trimming process. Structural damping inputs are discussed in detail in Section 3.3.7.2 which covers modal data input. Trim integration is controlled by O, the main rotor rotation speed and AZT the number of computations per rotor revolution. The integration interval is then

$$\Delta t = \frac{2\pi}{(AZT)(O)} \qquad (3\text{-}6)$$

A trim operational cutoff or limit stop is provided in the form of a maximum number of revolutions to trim, TCUT. If trim has not been

achieved by the specified number of revolutions, the TRIM mode is terminated and the FLY mode is entered. Values for the inputs of Table 3-12 are required.

TABLE 3-12. TRIM INTEGRATION DEFINITION			
Input Quantity			Address
Ω_R	0	Rotor speed, rad/sec	52
	AZT	Number of time points per revolution of trim	32
	TCUT	Maximum number of revolutions in trim	36

Past experience shows that a value less than 120 is marginal for AZT, and at times a value as high as 180 has been necessary. However, when the program is operated with all the high-frequency modes cut out; i.e., a "hard" swash-plate, no shaft bending, no blade torsion, no pitch horn bending, and only the first inplane and first flap mode operative, then a value of AZT=24 is possible.

Simply stated, trim is a state of system equilibrium. The function of the trim segment of the program is to reach that state. Pilot controls, vehicle attitude, and other system unknowns are determined such that starting boundary conditions are met by the equations of motion using a repeating solution. The appropriate values of the problem unknown are determined iteratively by a control algorithm of the form

$$x_{n+1} = x_n - f_n(a)Kdt \tag{3-7}$$

$$f_n(a) = e^{-dt/\tau} f_{n-1}(a) + a \tag{3-8}$$

where the subscript n denotes the nth computation point. Assuming a functional relationship between a and X, the above control relationship can be used to determine the value of X such that a = 0. Within REXOR it has not been found necessary to consider the controls and accelerations as a system. Independent relationships are assumed. Accelerations thus can be matched one to one with a control input. For example, vertical acceleration is only controlled by main rotor collective. Before proceeding, notice that there are two parameters in the control equation, namely τ and K, which can be used to control convergence. Indeed, these

are input parameters to REXOR. Experience has shown that tau, τ, should be set such that the ratio dt/τ remains a constant and near a value of 0.3. K is considered a gain factor and particular to the variables involved. Thus, a set of gains is defined in the input address, Table 3-13.

TABLE 3-13. TRIM GAINS

Input Quantity			Address
τ	TAU	Trim control time Constant	80
K	GAINT(1)	See Section 3.2 for complete definitions	1981
	.		.
	.		.
	.		.
	GAINT(19)		1999

The normal conditions for trim are

$$\dot{u}_F = \dot{v}_F = \dot{w}_F = \dot{p}_F = \dot{q}_F = \dot{r}_F = 0$$

The controls available to achieve these conditions are the attitude angles α_F, γ_F, ϕ_F, defined in Section 3.3.2, the propeller pitch, β_p, for compound helicopters, the tail rotor collective, θ_{TR}, the main rotor collective, θ_0, and the main rotor cyclic angles A_{1S} and B_{1S}. Since there are more unknown equations, a choice of active controls must be made. REXOR provides a number of trim options including autorotation and a so-called trim "tied to a post" where the longitudinal acceleration is left untrimmed. An input flag is used to communicate to the program the trim option desired. That flag is RA(142) = CORAF-1. Table 3-14 defines the trim options, indicates the functional relationships between the controls and the accelerations, and denotes which gains must be used. Notice that the control input addresses serve as initial guesses or constants, depending on their use.

Note that the main rotor cyclic angles, the tail rotor collective, and the roll angle trim the respective quantities $\dot{p}_F$, $\dot{q}_F$, $\dot{r}_F$, $\dot{v}_F$ to zero, no matter what the trim option. The accelerations $\dot{u}_F$ and $\dot{w}_F$ are trimmed to

TABLE 3-14. TRIM VARIABLE SCHEDULE

			Trim Controls				
		Name	BP	THO	ALPHA	GAMMA	ENDMZZ
		Initial Value	RA(53)	RA(56)	RA(58)	RA(63)	RA(92)
Trim Options RA(142) = CORAF-1	0	GAINT(I)	I = 1	I = 3	Trim Constant	Trim Constant	I = 9
		Nulled Quantity	$\dot{u}_F$	$\dot{w}_F$			$\ddot{\psi}_R$
	1	GAINT(I)	I = 1	Trim Constant	I = 3	Trim Constant	I = 9
		Nulled Quantity	$\dot{u}_F$		$\dot{w}_F$		$\ddot{\psi}_R$
	2	GAINT(I)	Trim Constant	I = 11	I = 3	I = 10	Trim Constant
		Nulled Quantity		$\ddot{\psi}_R$	$\dot{w}_F$	$\dot{u}_F$	
	2'	GAINT(I)	Trim Constant	I = 12	I = 3	I = 10	N/A
		Nulled Quantity		Rotor Torque	$\dot{w}_F$	$\dot{u}_F$	
	3	GAINT(I)	Trim Constant	I = 12	I = 3	Trim Constant	Trim Constant
		Nulled Quantity		Rotor Torque	$\dot{w}_F$		
	4	GAINT(I)	Trim Constant	I = 3	I = 3	Trim Constant	I = 9
		Nulled Quantity		$\dot{w}_F$	$\dot{u}_F$		$\ddot{\psi}_R$

Trim Options (CORAF-1)

0. Compound helicopter, collective trim, hover or forward flight.
1. Compound helicopter, angle of attack trim, forward flight.
2. Any helicopter, flight path angle trim with engine torque specified, RA(45) = CRSFG = 0.
2'. Any helicopter, autorotation, RA(45) = CRSFG = 1.
3. Any helicopter, "Tied to a Post", RA(45) = CRSFG = 0.
4. Any helicopter, hover or forward flight.

TABLE 3-14 - Continued

Trim Considerations:

1. For all flight trim options:

RA	Trim Variable	GAINT	Trims
54	A_{1S}	4	$\dot{p}_F$
55	B_{1S}	5	$\dot{q}_F$
57	THOTR	6	$\dot{r}_F$
59	PHI	2	$\dot{v}_F$

2. Trim constants must be specified except RA(53) = BP with no propeller, and RA(92) = ENDMZZ when RA(45) = CRSFG = 1.
3. See engine inputs for instructions to defeat engine torque output in autorotation (RA(142) = 2, RA(92) ≅ 0 and RA(45) = 0).

zero by a pair of trim variables chosen from propeller blade angle, main rotor collective, the angle of attack, and the flight path angle with the exception of RA(142) = 3. Note another trim variable, the engine trim torque ENDMZZ, is included in the table to trim the rotor. The rotor azimuth degree of freedom is often called the engine degree of freedom, which is perhaps a misnomer in autorotation where the engine inputs must be zeroed to prevent the engine from supplying torque.

There is nothing in the trim procedures to limit the aircraft attitude in trim. Vertical, sideways, or inverted flight are possible but unusual. Experience with the program in other than normal flight attitudes or in autorotation is limited. If the swashplate degrees of freedom are active, then three more trim conditions are added to the active trim option, and are given in Table 3-15.

TABLE 3-15. SWASHPLATE TRIM GAINS

Trim Control Name	Trim Control Address	Quantity Nulled	Gain Name	Gain Address
GLCON	69	$\ddot{\phi}_{sp}$	K_7	1987
GMCON	70	$\ddot{\theta}_{sp}$	K_{14}	1994
ZGS	1479	$\ddot{Z}_{sp}$	K_8	1988

The control gyro, if active, is trimmed as shown in Table 3-16.

TABLE 3-16. CONTROL GYRO TRIM GAINS

Trim Control Name	Trim Control Address	Quantity Nulled	Gain Name	Gain Address
GLCN	661	$\ddot{\phi}_g$	K_{13}	1993
GMCN	662	$\ddot{\theta}_g$	K_{13}	1993

Trim convergence is controlled by a set of simple convergence tests, all of which must be simultaneously satisfied. Movement of the controls (quiescence) is monitored rather than relative zero tests on the accelerations. Control parameters are first compared after four rotor revolutions, and compared every two revolutions thereafter. In the tests that follow, the prime denotes values two revolutions later.

$$\left| \beta_p' - \beta_p \right| < 0.001$$

$$\left| A_{1S}' - A_{1S} \right| < 0.001$$

$$\left| B_{1S}' - B_{1S} \right| < 0.001$$

$$\left| \theta_0' - \theta_0 \right| < 0.001$$

$$\left| \theta_{TR}' - \theta_{TR} \right| < 0.001$$

$$\left| \phi_E' - \phi_E \right| < 0.01$$

$$\left| \gamma\alpha' - \gamma\alpha \right| < 0.01$$

$$\left| \alpha' - \alpha \right| < Q \quad \text{where } Q = 0.01 \text{ if HPSET} \neq 0$$

$$Q = 0.001 \text{ otherwise}$$

$$\left| G_{L'_{CON}} - G_{M_{CON}} \right| < 20$$

$$\left| G_{M'_{CON}} - G_{M_{CON}} \right| < 20$$

$$\left| G_{L'_{CN}} - G_{L_{CN}} \right| < 1$$

$$\left| G_{M'_{CN}} - G_{M_{CN}} \right| < 1$$

HPSET is RA(1936). The rate of trim convergence is controlled by size of the trim gains. A trim gain too high causes a convergence failure ("bomb"), a value too low wastes computer time. The program does not automatically determine the trim gains. The usual procedure is to make a guesstimate of the value based on past experience and observe the trim time-history plot. The gain can be increased on slow-to-trim variables, and decreased on those that appear to be oscillating or following the vibratory component of the accelerations as well as the mean.

One specialized mode of operation which requires attention during trim is the so-called "fixed shaft" run in which only the main rotor and swash-plate are considered. A fixed shaft run is activated by setting the input NGORF = RA(133) to some non-zero value. A fixed shaft run can be trimmed to a specified rotor lift and shaft roll and pitch moments. The inputs are given in Table 3-17.

TABLE 3-17. FIXED SHAFT TRIM

	Input Quantity	Address
TRIMQ(1)	Desired Rotor Roll Moment + RT, ft-lb	33
TRIMQ(2)	Desired Rotor Pitch Moment + N.UP, ft-lb	34
TRIMQ(3)	Desired Rotor Lift + UP, lb.	35

For trimming purposes, the moments and lift are transformed into accelerations.

$$\dot{w}_F = \ddot{Y}_{23} = \left(F_{Z_R} + \text{TRIMQ}(3)\right)/M_R \tag{3-9}$$

$$\dot{p}_F = \ddot{Y}_{24} = \left(M_{XX_R} - \text{TRIMQ}(1)\right)/I_{XX_R} \tag{3-10}$$

$$\dot{q}_F = \ddot{Y}_{25} = \left(M_{YY_R} - \text{TRIMQ}(2)\right)/I_{YY_R} \tag{3-11}$$

The required trim gains are determined by the trim option in effect.

Effort and computer time can be reduced for repeated or similar cases by the use of an option known as "trim save." The actuation of IPUNCH = RA(47) causes trim cards to be punched of pertinent values at the end of a successful trim. These trim cards in RA format may be used to initialize a case at similar conditions. They should be used with care to be sure the desired flight conditions are not being overridden by these trim save cards. "Trim save" data can also be saved internally in the program by activating a flap known as TRMUPD = RA(2000). It is intended to save trim computing time when the next case is similar to the preceding one.

Table 3-18 gives all of the addresses which will be punched if IPUNCH = 1.

TABLE 3-18. TRIM PUNCH CARDS

Quantity	Addresses
CASE	50
BP	53
A1S	54
B1S	55
THO	56
THOTR	57
ALPHA	58
PHI	59
VT	62
GAMMA	63
(OPEN)	64
WIMR	65
PIMR	66
QIMR	67
(OPEN)	68
GLCON	69
GMCON	70
WIMRD	71
PIMRD	72
QIMRD	73
WIMRN1	74
PIMRN1	75
QIMRN1	76
A1TR	77
W1TR	78
GLCN	661
GMCN	662
CZERO	1252
Y(1) -Y(30)	1661-1690
YD(1) - YD(30)	1691-1720
YDD(1) - YDD(30)	1721-1750
THTORS(40,4)	2001-2160
THTRD(40,4)	2161-2320
THG1 (40,4)	2321-2480
DPF(4)	2801-2804
DPFD(4)	2805-2808
DPF1(4)	2809-2812
DPF2(4)	2813-2816

3.3.4 FLY

Upon the successful completion of TRIM, the FLY mode may be entered. During the FLY mode, the complete system of equations, as defined by the user, is integrated for a specified period of equivalent real time. A variety of control inputs may be exercised, and are discussed below. The user controls the FLY time history with three input parameters. The integration step size during FLY is determined by the relation

$$dt = 2\pi / (NAZ)(\Omega) \tag{3-12}$$

which is the same relation as is used for TRIM with the exception that step increment NAZ is input in RA (51) for FLY. The parameter TSTOP (RA 1498) is the duration of FLY in seconds. A special integration control, GINT (RA 61), is provided for the control gyro. The control gyro degrees of freedom are integrated separately. The integration step size is computed as

$$dt_G = dt/GINT \tag{3-13}$$

where GINT $\geq$ 1, and dt is the normal FLY integration interval.

> WARNING: This feature is not compatible with the flexible shaft degrees of freedom.

3.3.4.1 Pilot Input

A pilot can be simulated with a time history of control displacements as inputs. The displacements can be those for a step, a pulse, etc., or the actual time history of the control displacements from flight tests. This input is only the incremental maneuvering input over and above that required for trim. The pilot controls are lateral and longitudinal stick position, main rotor collective angle, tail rotor collective angle, propeller blade angle, and rotor speed. The rotor speed input is operative only when the rotor speed degree of freedom is off. The pilot inputs for main and tail rotor collectives are equivalent to the cockpit collective handle and rudder pedals. The vertical swashplate degree of freedom changes the pilot's collective setting at the rotor, and a tail rotor damper changes the actual tail rotor collective from the pilot command. The pilot control commands are inputted to the program in tabular form as a function of time. One table of time values is used in connection with all command tables.

To illustrate the procedure consider Figure 3-5. Assume the desired data points for three functions, y_1, y_2, and y_3 are denoted by the circles. Each function is individually projected onto the time axis. Then the total set of time points is reprojected onto each function as Δ's. The resultant time table will be the total set of time points and values at the Δ's as well as the O's. All functions are linearly interpolated. Functions are evaluated as constant for times beyond the last time point, i.e., no extrapolation. A step function must be approximated with a ramp. More specifically, the table times must adhere to the relation

$$t_n - t_{n-1} > dt \tag{3-14}$$

where dt is the integration step size. If the second time table value is zero, then the program assumes no pilot inputs. The tables are restricted to twenty (20) points. The number of points used is required as an input. The controls and addresses are given in Table 3-19.

In the equations that follow, the value of a function resulting from a pilot table lookup will be subscripted with a (P). The trimmed value of a control will be denoted with a subscript (T).

The resultant propeller pitch, β_P, is then

$$\beta_P = \beta_{P,P} + \beta_{P,T} \tag{3-15}$$

The resultant main rotor collective is not only a function of pilot maneuvering and trim, but also swashplate motion.

$$\theta_O = \theta_{O,T} + \theta_{O,P} - (Z_{SP} - Z_{SP,T})/e \tag{3-16}$$

where e is the pitch horn arm. Note that Z_{SP} and $Z_{SP,T}$ are made equal at the end of trim.

If the engine degree of freedom is not active, then a variable rotor speed can be simulated by inputting a differential speed in PSITB(20) as described above, resulting in the equation

$$\dot{\psi}_R = \Delta\dot{\psi}_{R,P} + \Omega \tag{3-17}$$

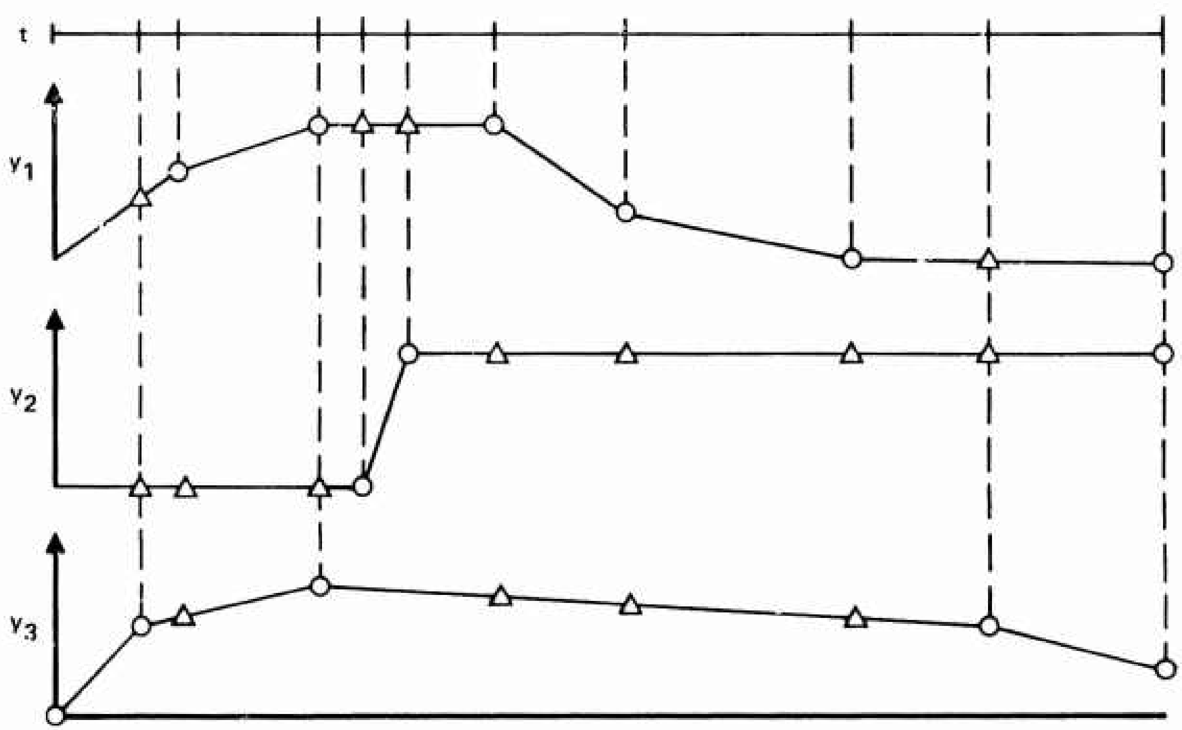


Figure 3-5. Pilot Command Data.

TABLE 3-19. CONTROL INPUTS		
Input Quantity		Address
NMP	Number of points in control tables	150
PT(20)	Pilot time table, sec	151-170
PXCS(20)	Pilot longitudinal stick displ. (+) aft, ft	171-190
PYCS(20)	Pilot lateral stick displ. (+) right, ft	191-210
PTHO(20)	Pilot collective input (+) thrust, rad	211-230
PTHOTR(20)	Pilot tail rotor coll. input (+) thrust, rad	231-250
PBP(20)	Pilot prop. blade angle input (+) thrust, rad	251-270
PSITB(20)	Pilot engine speed, rad/sec differential from nominal	641-660

where

$$\Omega = RA(52)$$

The trim plus maneuvering stick travel has limits imposed by the stops RA(31) = XCSMAX and RA(494) = YCSMAX. The pilot stick actuators are represented by simple first-order lag with time constants RA(292) = TCX and RA(293) = TCY. The actuators are also rate limited. In terms of stick rates these inputs are RA(437) = XCPDL and RA(438) = YCPDL.

3.3.4.2 Control Devices

A number of control system stability augmentors, linkage compensators and sensitivity devices exist in the REXOR code. Some are of a general nature whereas some represent a problem fix for a particular application.

A tail rotor yaw damper and actuator is modeled. RA(1278) = RRK is the feedback gain between yaw rate and tail rotor collective, and RA(1279) = TWTR is the washout time for this feedback loop. The

actuator time constant is given by RA(1280) = TCTRA. See Figure 3-6 for a diagram.

The helicopter can be artifically stabilized by an artifical stick stabilizer for special studies. The formulation permits specifying a time history of the pitch attitude, RA(1501) = TTB(1) and following points. The equations are

$$\dot{X}_{CS} = A_\theta (\theta_H - \theta_{H,T} - A_{\theta,C}\, \theta_{H,C}) + B_\theta (q_H - q_{H,T}) \tag{3-18}$$

and

$$\dot{Y}_{CS} = A_\phi (\phi_H - \phi_{H,T}) + B_\phi (p_H - p_{H,T}) \tag{3-19}$$

which indicate increments from trim of the roll angle and the pitch angle of the principal axis and their time rates being used as feedback to the stick. The feedback gains A_θ, etc., are not input, rather $A'_\theta = A_\theta\ \Delta t$, etc., such that

$$\Delta X_{CS} = A'_\theta (\theta_H - \theta_{H,T} - A_{\theta,C}\, \theta_{H,C}) + B'_\theta (q_H - q_{H,T}) \tag{3-20}$$

and

$$\Delta Y_{CS} = A'_\phi (\phi_H - \phi_{H,T}) + B'_\phi (p_H - p_{H,T}) \tag{3-21}$$

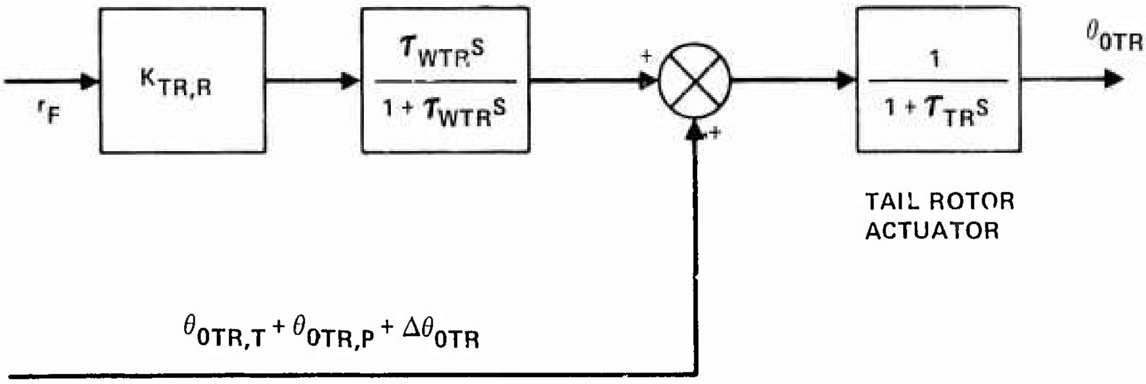
The increments $\Delta X_{C,S}$ and $\Delta Y_{C,S}$ are added to the stick positions at every time point. In a similar manner

$$\Delta\theta_{OTR,S} = A'_\psi (\psi_H - \psi_{H,T}) + B'_\psi (r_H - r_{H,T}) \tag{3-22}$$

which is an input added to the tail rotor collective over and above that added by the yaw damper. The inputs of interest are

RA(664) = APHI = A'_ϕ

RA(665) = BPHI = B'_ϕ



LEGEND:

$K_{TR,R}$	YAW DAMPER GAIN
r_F	FUSELAGE YAW RATE
$\theta_{0TR,T}$	TRIM TAIL ROTOR COLLECTIVE
$\theta_{0TR,P}$	PILOT'S TAIL ROTOR COLLECTIVE INCREMENT
θ_{0TR}	TRUE TAIL ROTOR COLLECTIVE
τ_{TR}	TAIL ROTOR COLLECTIVE ACTUATOR TIME CONSTANT
τ_{WTR}	YAW DAMPER WASHOUT TIME CONSTANT
$\Delta\theta_{0TR}$	SEE SECTION 3.3.4.2

Figure 3-6. Yaw Damper.

RA(666) = APSI = A'_ψ

RA(667) = BPSI = B'_ψ

RA(668) = ATH = A'_θ

RA(669) = BTH = B'_θ

RA(670) = ATC = $A_{\theta,C}$

RA(1501) = TTB(1) = $\theta_{H,C}$

and following TTB is used in conjunction with the pilot time points elements starting with RA(151) = PT(1).

Several control devices are programmed which were flight tested on early versions of the AH-56A helicopter. The devices are a longitudinal stick desensitizer, a lateral stick desensitizer, a pitch-roll decoupler and a lift-roll decoupler. See Figures 3-7 and 3-8 for math model schematics. All but the lift-roll decoupler are flagged by RA(90) = IPITCH. The lift-roll decoupler is turned on by RA(1499) = IDECUP = 1. The inputs associated with each device are as follows:

Longitudinal stick desensitizer

RA(581) = VEQ1 = V_{e1}

RA(582) = DVEQ1 = ΔV_{e1}

RA(585) = KXCS = K_{XC}

RA(588) = XCS1 = L_{XC1}

RA(589) = XCS2 = L_{XC2}

Lateral stick desensitizer

RA(586) = KYCS = K_{YC}

RA(590) = YCS1 = L_{YC1}

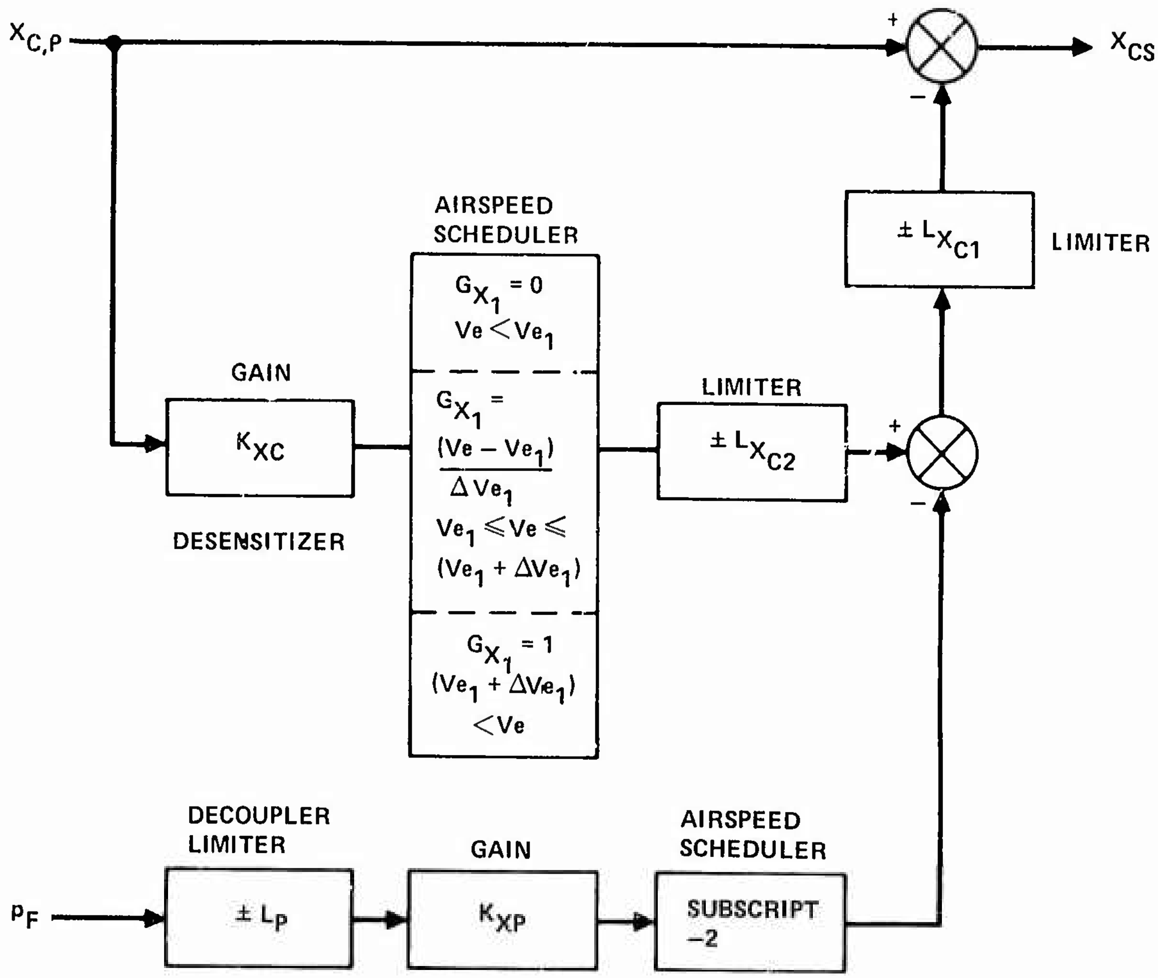
Pitch roll decoupler

RA(583) = VEQ2 = V_{e2}

RA(584) = DVEQ2 = ΔV_{e2}

RA(587) = KXPR = K_{XP}

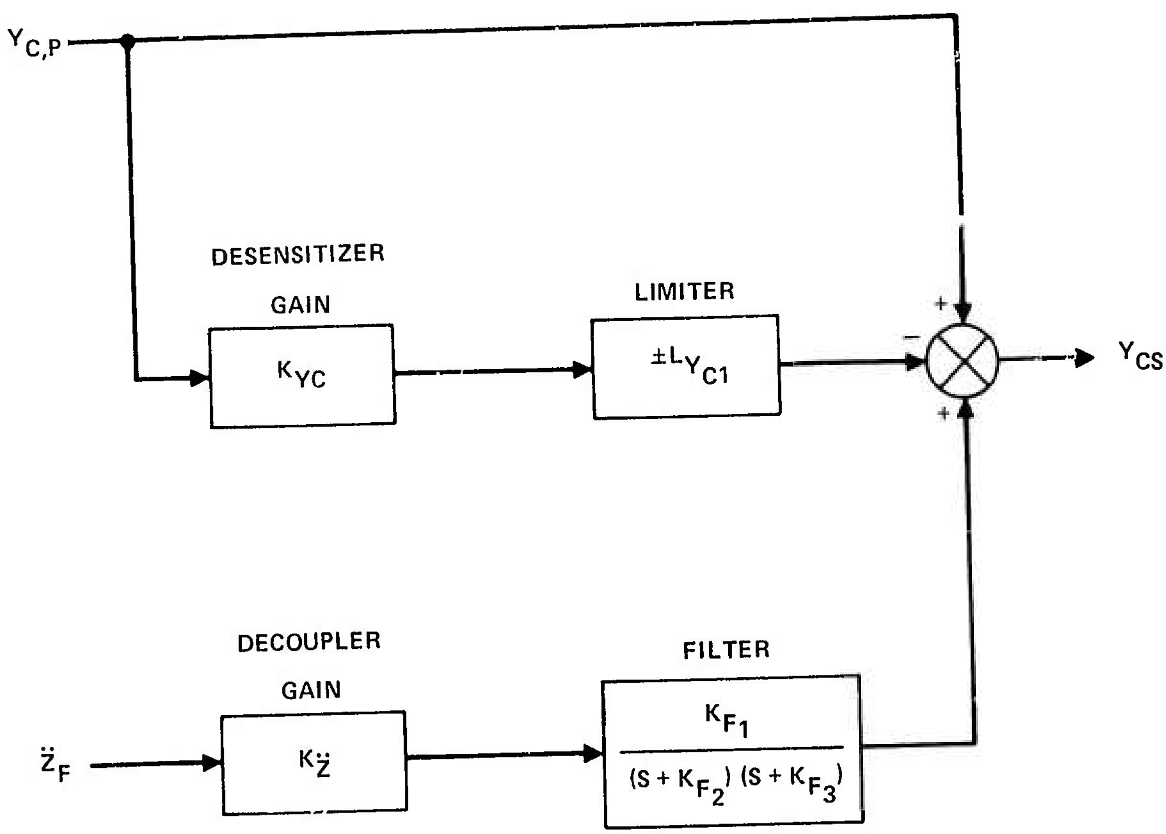
RA(589) = XCS2 = L_{XC2}



LEGEND:

P_F	FUSELAGE PITCH RATE
$Ve = V_F\sqrt{\rho/\rho_0}$	EQUIVALENT AIRSPEED
K_{XC}, K_{XP}	SYSTEM GAINS
Ve_1, Ve_2	SCHEDULER BREAKPOINTS
ΔVe_1, ΔVe_2	SCHEDULER SLOPES
$X_{C,P}$	PILOT COMMAND LONGITUDINAL STICK
X_{CS}	ACTUATOR COMMAND LONGITUDINAL CYCLIC

Figure 3-7. Longitudinal Stick Desensitizer and Pitch-Roll Decoupler.



LEGEND:

Y_{CP}	PILOT COMMAND LATERAL STICK
Y_{CS}	ACTUATOR COMMAND LATERAL STICK
$K_{YC}, K_{\ddot{Z}}, K_{F_1}$	SYSTEM GAINS
K_{F_2}, K_{F_3}	FILTER BREAKPOINTS
L_{YC1}	LIMITER
$\ddot{Z}_F$	FUSELAGE VERTICAL INERTIAL ACCELERATION

Figure 3-8. Lateral Stick Desensitizer and Lift-Roll Decoupler.

The limit for the roll rate that is feedback for the pitch-roll decoupler and all the lift-roll decoupler feedback constants are values which are built into the program.

Flight profile following autopilots have been used in REXOR and some elements may exist in the code. However, due to the specialized nature of the code and lack of documenting information this area of the code is not considered operational. The inputs involved are RA(680) through RA(760), RA(1901) through RA(1935) and RA(1939) through RA(1980).

3.3.4.3 Lockout of Degrees of Freedom

REXOR is configured to analyze a rotorcraft represented by a basic set of generalized coordinates, together with optional additions or deletions. This basic set consists of three blade modes for each of four blades: three swashplate degrees of freedom; one rotor degree of freedom; and six hub degrees of freedom. The user, via input controls, can add or subtract to this basic set. The input flags and their meaning are discussed below.

Hub:

The six hub degrees of freedom can be removed by setting

NGORF (RA 133) = 1.

This option is further discussed in Section 3.3.3.

Rotor Rotation:

The main rotor rotation rate, $\dot{\psi}_R$, can be held constant, i.e.,

$$\dot{\psi}_R = \Omega$$

$$\ddot{\psi}_R = 0$$

by setting

CRSFG (RA 45) = 1.0

This degree of freedom is sometimes referred to as the engine.

Swashplate:

A hard swashplate (stiff support springs) is obtained by setting

HARDSP (RA 42) = 1.0

which locks out the swashplate degrees of freedom. In this mode, the swashplate is geared to the pilot cyclic stick.

Second Flap Bending:

The blade second flap mode can be removed by setting

FLAP2 (RA 2515) = 1.0.

The necessary adjustment of input data associated with the second flap is handled by the program.

Single Blade:

For special studies, the user may wish to operate just one blade. When

SNGBLF (RA 60) = 1.0,

a maximum of four degrees of freedom for blade 1 are operative. These are the three blade bending modes plus the dynamic pitch horn or dynamic torsion mode. Experience with this option is limited.

Shaft Bending:

Two shaft bending degrees of freedom, ϕ_s and θ_s, can be activated by setting

IFLEX (RA 399) = 1.

This option is not compatible with the fixed hub option. A complete treatment of shaft bending as an option is presented in Section 3.3.16.

Pitch Horn:

A pitch horn bending degree of freedom for each blade can be activated by setting

IPHORN (RA 1480) = 1.0.

A full discussion of pitch horn bending and its associated inputs is presented in Section 3.3.7.4.

Dynamic Torsion:

A dynamic torsion degree of freedom for each blade can be activated by setting

IDYN (RA 2870) = 1.0.

A further discussion of dynamic torsion can be found in Section 3.3.7.5. This option is incompatible with pitch horn bending.

Control Gyro:

The activation of the control gyro degrees of freedom, ϕ_G and θ_G, is accomplished by setting

IAMCS (RA 490) = 1.0.

This option is completely discussed in Section 3.3.15.

Teetering Rotor:

A teetering rotor simulation is activated by setting

TEETER (RA 663) = 1.0.

When activated, the number of blades is automatically reduced to two and the blade flapping modes are redefined. See Volume I, Section 6.7 for details.

3.3.4.4 Reactionless Inplane Excitation

The three constants starting with RA(1491) = RTWANG(1) input an artificial increment to the inplane mode displacement for inplane damping studies. The increment is applied +, -, + and - to blades 1,2,3 and 4 to excite the reactionless mode directly. (The reactionless mode is difficult to excite by pilot stick displacement because only second-order effects are involved.) The twang is suitable only for a four-bladed rotor and occurs after the first two revolutions in FLY. TWANG(1) is the input at the first time point (which is usually sufficient to excite the mode); TWANG(2) at the second time point; and TWANG(3) at the third.

3.3.5 Output Options

The user can call up a number of outputs from REXOR. For discussion purposes, they will be categorized according to output media, i.e., print, punch, plot, and tape.

3.3.5.1 Print

REXOR print output is primarily for diagnostic purposes. The format of the printing is given in Section 5. The control and use of the available print data is discussed below.

The generalized mass matrix can be optimally printed by setting

ICONTR (RA 46) = 1.0

When activated, the mass matrix will be printed twice: once at the beginning of TRIM and again at the beginning of FLY. The output format is self-explanatory.

TRIM diagnostic print can be generated by setting

IPRINT (RA 49) = 1.0.

When activated, the block of print data described in Section 5 will be printed every time point for the first rotor revolution. This option generates a great deal of print and should be used sparingly.

Although Harmonic Analysis is an optional printout, it will be discussed separately in Section 3.3.6.

3.3.5.2 PLOT

Plot (graphic) output is the primary form of REXOR output, and is controlled by the user via

IPLOT (RA 48),

where:

IPLOT = 0 no plots

= 1 TRIM only

= 2 FLY only

= 3 plot TRIM and FLY

= 4 special addition to FLY plots.

All plots are time histories. The format is similar to a strip chart recorder, i.e., there is a reference signal and four 2-inch channels per frame.

Figure 3-9 shows a typical block of data. The reference signal is the sine of the azimuth of blade 1, together with a ruler-like scale with divisions every 90 degrees. Each signal is identified with an abbreviated title which usually includes the units. The positive axis is identified with some physical interpretation. Finally, a number is printed which represents the axis scale in units per inch. Scaling will be explained in detail below.

The plotting algorithm is table driven, i.e., a master list of output signals are defined. The user, via input, specifies which signals he wishes to see plotted. Each signal is identified by a signal number and is referred to by that number. TRIM plots and FLY plots are handled separately. During TRIM a maximum of forty signals may be plotted. The signal definition table is presented in Table 3-20. The abscissa scale for TRIM plots is fixed at four rotor revolutions per inch of paper. All ordinate scales are determined by the program. The plot frequency is determined automatically such that approximately 50 points per inch are plotted.

The user chooses from the TRIM signal definition table, the signals he wishes to be plotted.

The signals are entered into the input table (NVEC1 (RA 301 through RA 340) by number. The number of signals plotted must be entered in NVAR1 (RA 299). The reader can refer to Section 3.2 for an example. The signals are plotted in the order they appear in the input table, four signals per frame counting from bottom to top.

The effective sweep and droop calculations which are available for output can be made at a specified station location. The desired location, in feet, is input in DSTAF (RA 297). If no input is made, then calculations will be at the tip of the blade.

The user can call for the plotting of up to 50 signals during FLY. The FLY signal definition table is presented in Table 3-21. The user lists the plot signal numbers in NVEC2 (RA 1801 through RA 1850). The number of signals plotted must be input in NVAR2 (RA 300). See Section 3.2 for examples.

During FLY, the user has plot scale control. Two inputs determine the abscissa scaling. CYCFLG (RA 134) determines the type of units where

RA(134) = 0 gives seconds/inch

RA(134) = 1 gives revolutions/inch.

TCSLE (RA 298) is the scaling magnitude. The inputs of

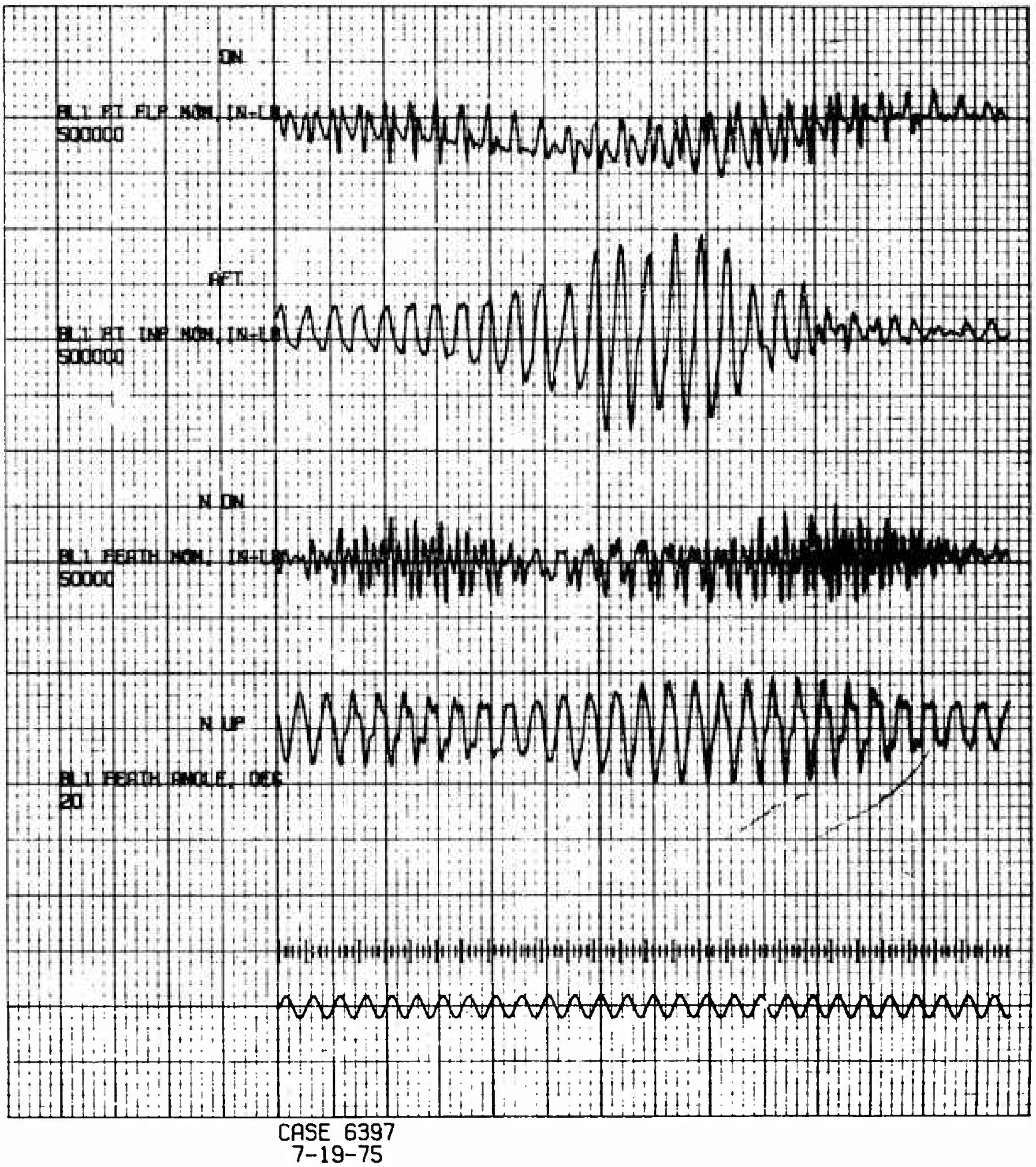


Figure 3-9. Typical Block of Time History Data.
(Sheet 1 of 2)

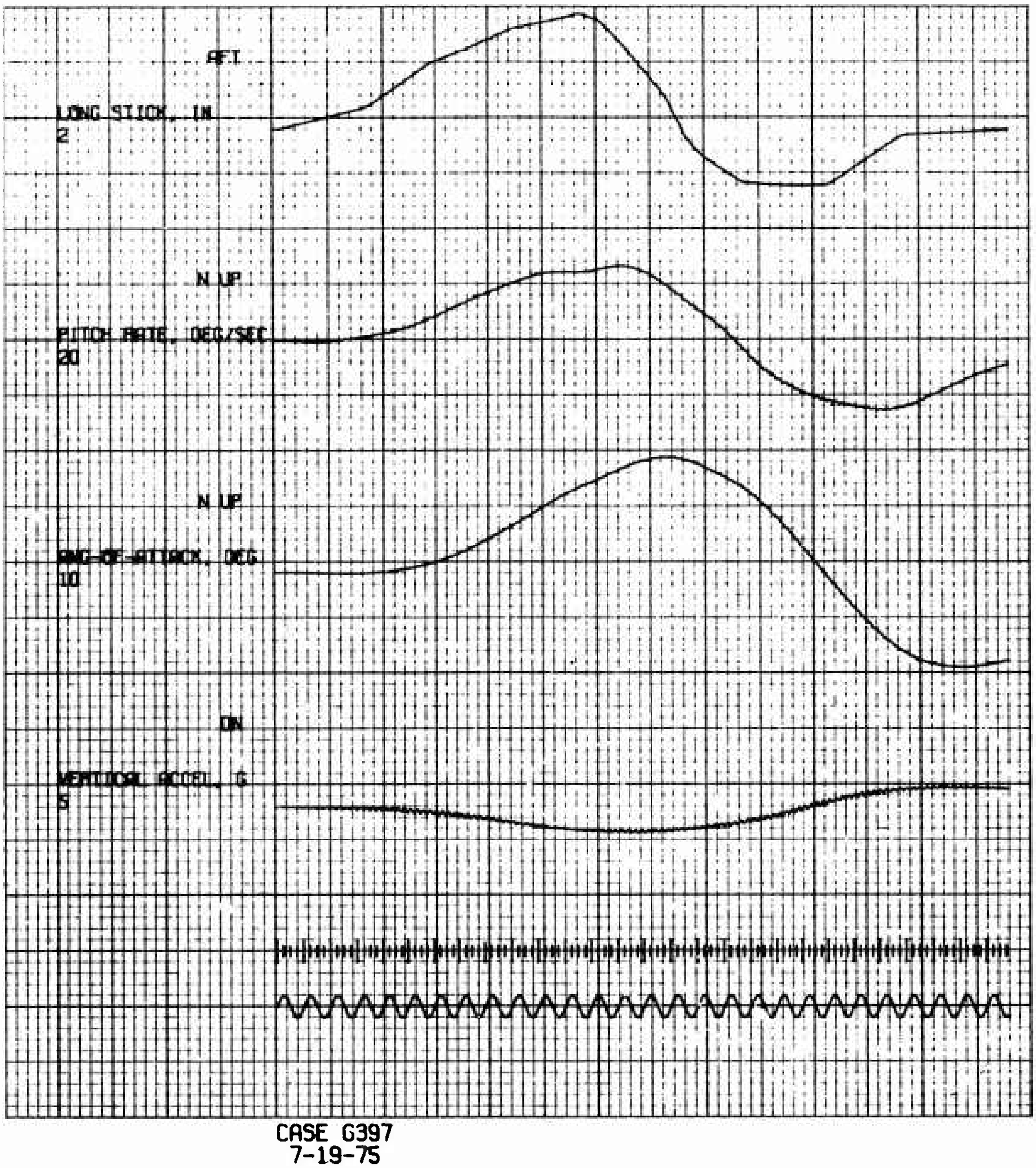


Figure 3-9. Typical Block of Time History Data.
(Sheet 2 of 2)

TABLE 3-20. TRIM PLOT SIGNAL TABLE

Signal #		Definitions	Plot Label	Axis Label
1	$\dot{u}_H$	Longitudinal hub velocity derivative	LONG ACCEL, G	FWD
2	$\dot{v}_H$	Lateral hub velocity derivative	LATERAL ACCEL, G	RT
3	$\dot{w}_H$	Vertical hub velocity derivative	VERTICAL ACCEL, G	DN
4	ϕ_E	Hub bank angle in earth axis	BANK ANGLE, DEG	RT
5	β_p	Propeller pitch angle	PROP BLADE ANGLE, DEG	N UP
6	θ_o	Main rotor collective	COLL PITCH, DEG	N UP
7	α_F	Fuselage angle of attack	ANG-OF-ATTACK, DEG	N UP
8	A_{1S}	Lateral cyclic pitch angle	LAT CYC PITCH, DEG	N DN
9	B_{1S}	Longitudinal cyclic pitch angle	LONG CYC PITCH, DEG	N DN
10	$\dot{p}_H$	Roll hub acceleration	ROLL ACC, DEG/SEC SQ	RT
11	$\dot{q}_H$	Pitch hub acceleration	PITCH ACC, DEG/SEC SQ	N UP
12	$\dot{r}_H$	Yaw hub acceleration	YAW ACC, DEG/SEC SQ	N RT
13	θ_{OTR}	Tail rotor collective	TAIL ROT PITCH, DEG	N UP
14	X_C	Longitudinal stick position	LONG STICK, IN	AFT
15	Y_C	Lateral stick position	LATERAL STICK, IN	RT
22	$\ddot{\phi}_{SP}$	Swashplate roll acceleration	S PL RCLL ACC, DEG/S2	RT

TABLE 3-20 - Continued

Signal #		Definitions	Plot Label	Axis Label
33	ϕ_G	Control gyro roll and pitch angles	GYRO ROLL ANGLE, DEG	RT
34	θ_G		GYRO PITCH ANGLE, DEG	UP
43	$\ddot{Z}_{SP}$	Swashplate vertical acceleration	SW PL VERT ACC, IN/S2	DN
46	Z_{SP}	Swashplate vertical displacement	SWASH PL VERT DIS, IN	DN
47	θ_{OT}	True main rotor collective	TRUE COLLECTIVE, DEG	N UP
51	A_{1ST}	True main rotor lateral cyclic	TRUE LAT CYC, DEG	N DN
52	B_{1ST}	True main rotor longitudinal cyclic	TRUE LONG CYC, DEG	N DN
53	A_{11}	Blade 1, mode 1 tip displacement	INPL MODE DISP, IN	AFT
55	A_{21}	Blade 1, mode 2 tip displacement	1ST FLAP DISP, IN	DN
56	A_{31}	Blade 1, mode 3 tip displacement	2ND FLAP DISP, IN	DN
59	$G_{L_{CON}}$	Swashplate roll moment	S PL ROLL MOM, IN-LB	RT
60	$G_{M_{CON}}$	Swashplate pitch moment	S PL PITCH MOM, IN-LB	N UP
78	A_{1TR}	Tail rotor longitudinal flap angle	T. ROT. LONG. FLAP	PLUS
79	w_{iMR}	Vertical downwash	VERTICAL DOWNWASH	PLUS
80	p_{iMR}	Roll downwash	ROLL DOWNWASH	PLUS
81	q_{iMR}	Pitch downwash	PITCH DOWNWASH	PLUS

TABLE 3-20 - Continued

Signal #		Definitions	Plot Label	Axis Label
83	$\ddot{\phi}_G$	Gyro roll acceleration	GYRO ROLL ACC, DEG/S2	RT
84	$\ddot{\theta}_G$	Gyro pitch acceleration	GYRO PITCH AC, DEG/S2	RT
85	γ	Flight path angle	ANG OF DESCENT, DEG	RT
86	$\ddot{\psi}_R$	Engine acceleration	ENGINE ACC, RAD/S2	N UP
87	$M_{ZZ_{END}}$	Engine torque	ENGINE TORQUE, FT-LBS	DN
88	Y_{1S}	Effective sweep	EFFECTIVE SWEEP, DEG	PLUS
89	Z_{1S}	Effective droop	EFFECTIVE DROOP, DEG	PLUS
90	w_{iTR}	Tail rotor downwash	TAIL ROTOR DOWNWASH	PLUS

TABLE 3-21. FLY PLOT SIGNAL TABLE

Signal #		Definitions	Plot Label	Axis Label
1	$\dot{u}_H$	Longitudinal hub velocity derivative	LONG ACCEL, G	FWD
2	$\dot{v}_H$	Lateral hub velocity derivative	LATERAL ACCEL, G	RT
3	$\ddot{Z}_{OH}$	Vertical acceleration of hub in inertial space	VERTICAL ACCEL, G	DN
4	ϕ_E	Hub bank angle, earth axis	BANK ANGLE, DEG	RT
5	β_P	Propeller pitch angle	PROP BLADE ANGLE, DEG	N UP
6	θ_o	Main rotor collective	COLL PITCH DEG	N UP
7	α_F	Fuselage angle of attack	ANG OF ATTACK, DEG	N UP
13	θ_{OTR}	Tail rotor collective	TAIL ROT PITCH, DEG	N UP
14	X_C	Longitudinal stick position	LONG STICK, IN.	AFT
15	Y_C	Lateral stick position	LATERAL STICK, IN.	RT
16	p_F	Fuselage roll velocity	ROLL RATE, DEG/SEC	RT
17	r_F	Fuselage pitch velocity	YAW RATE, DEG/SEC	N RT
18	$-Z_{OH_E}$	Altitude variation from ground	ALT. VARIATION, FT	PLUS
19	β_F	Fuselage angle of sideslip	ANG-OF-SIDESLIP, DEG	N LT

TABLE 3-21 - Continued

Signal #		Definitions	Plot Label	Axis Label
20	Z_{SP}	Swashplate vertical displacement	SWASH PL VERT DIS, IN	DN
21	q_F	Fuselage pitch velocity	PITCH RATE, DEG/SEC	N UP
23	$M_{Y_{BL1}}$	Blade 1 root flap moment	BL1 RT FLP MON, IN-LB	DN
24	$M_{Z_{BL1}}$	Blade 1 root inplane moment	BL1 RT INP MON, IN-LB	AFT
25	$M_{X_{F1}}$	Blade 1 feather moment	BL1 FEATH MON, IN-LB	N DN
26	$M_{X_{MR,H}}$	Main rotor hub roll moment	SHFT ROLL MON, IN-LB	RT
27	$M_{Y_{MR,H}}$	Main rotor hub pitch moment	SHFT PITCH MON, IN-LB	N UP
28	HP_{MR}	Main rotor hub horsepower	MAIN ROTOR HP	PLUS
29	$F_{Z_{MR,H}}$	Main rotor axial force	SHAFT AXIAL LOAD, LB	DN
30	ϕ_{F1}	Blade 1 feather angle	BL1 FEATH ANGLE, DEG	N UP
31	-	Lateral cyclic inplane moment, hub axis	LAT INPL MON, IN-LB	RT
32	-	Longitudinal cyclic inplane moment, hub axis	LONG INPL MON, IN-LB	N UP
33	ϕ_G	Control gyro roll angle (AMCS only)	GYRO ROLL ANGLE, DEG	R
34	θ_G	Control gyro pitch angle (AMCS only)	GYRO PITCH ANGLE, DEG	UP
35	-	Lateral cyclic inplane moment, rotor axis	CYC 1 INPL MON, IN-LB	AFT

TABLE 3-21 - Continued

Signal #		Definitions	Plot Label	Axis Label
36	-	Engine horsepower required	ENGINE HP	PLUS
37	-	Longitudinal cyclic inplane moment, rotor axis	CYC 2 INP MON, IN-LB	AFT
38	-	Reactionless inplane moment	REACT INPL MON, IN-LB	AFT
39	-	Swashplate collective spring and damping load	COLL SERVO LOAD, LB	DN
40	-	Reactionless flap moment	REACT FLAP MON, IN-LB	DN
41	$M(5)_{X_{BLE}}$	Blade 1 torsion at station 5	BL TORS AT STA 131.5	UP
42	θ_E	Hub pitch attitude, earth axis	PITCH ATTITUDE, DEG	N UP
44	$-\dot{Z}_{OHE}$	Hub rate of climb	VERT. VEL, FPM	PLUS
45	ϕ_{BL1}	Blade 1 root twist	BL1 EL TIP TWIST, DEG	N DN
47	θ_{OT}	True main rotor collective	TRUE COLLECTIVE, DEG	N UP
48	A_{2ST}	True main rotor reactionless feather angle	REACT. BL. ANG., DEG	PLUS
49	-	Swashplate of control gyro (AMCS only) roll "feedback" moment	GYRO FB R MON, IN-LB	RT
50	-	Swashplate or control gyro (AMCS only) pitch "feedback" moment	GYRO FB P MON, IN-LB	N UP

TABLE 3-21 - Continued

Signal #		Definitions	Plot Label	Axis Label
51	A_{1ST}	True main rotor lateral cyclic	TRUE LAT CYC, DEG	N DN
52	B_{1ST}	True main rotor longitudinal cyclic	TRUE LONG CYC, DEG	N DN
53	A_{11}	Blade 1, mode 1 tip displacement	INPL MODE DISP, IN	AFT
54	V_e	Equivalent airspeed	AIRSPEED, KEAS	FWD
55	A_{21}	Blade 1, mode 2 tip displacement	1ST FLAP DISP, IN	DN
56	A_{31}	Blade 1, mode 3 tip displacement	2ND FLAP, DISP, IN	DN
57	ϕ_{SP}	Swashplate roll angle (AMCS only)	SWSH PL ROLL ANG, DEG	RT
58	θ_{SP}	Swashplate pitch angle (AMCS only)	SWSH PL PITCH ANG, DEG	N UP
59	$\partial U/\partial \phi_{SP}$	Swashplate spring roll moment (AMCS only)	S PL ROLL MON, IN-LB	RT
60	$\partial U/\partial \theta_{SP}$	Swashplate spring pitch moment (AMCS only)	S PL PITCH MON, IN-LB	N UP
68	$-M(2)_{Y_{BLE}}$	Blade 1 flap moment at station 2	BL1 FLAP MOM - STA 2	-
69	$M(2)_{Z_{BLE}}$	Blade 1 inplane moment at station 2	BL1 INPL MOM - STA 2	-
70	$-M(3)_{Y_{BLE}}$	Blade 1 flap moment at station 3	BL1 FLAP MOM - STA 3	-
71	$M(3)_{Z_{BLE}}$	Blade 1 inplane moment at station 3	BL1 INPL MOM - STA 3	-
82	$\Delta\dot{\psi}_R$	Rotor speed variations	PERCENT RPM FROM NOM	PLUS

RA(298) = 1

RA(134) = 0

would produce a scale of 1 second per inch of plot. An abscissa scale of revolutions (cycles) per inch is meaningful only for constant rotor speed runs. The program automatically scales each signal to fit the two-inch channel. However, the user may specify scaling. Ordinate scales are entered in SVEC (RA 1851 through RA 1900). Entries in SVEC must parallel NVEC2. For example, if one wished to override the scaling of the third function plotted, then he would enter the desired scale in SVEC(3) = RA(1853).

The special plot option controlled by the input IPLOT = 4 will produce the TRIM and the FLY plot obtained with IPLOT = 3. In addition, a plot at an expanded time scale of 0.25 revolutions per inch is obtained at the end of FLY. The program adds an extra 0.5 sec to RA(1498) = TSTOP for the expanded plots.

3.3.5.3 Punch

The program can produce BCD (Binary Coded Decimal) punch cards. TRIM save cards are punched when IPUNCH (RA 47) = 1. This is explained in Section 3.3.3.

A data deck editing feature is also available. If EDIT (RA 104) = 1 is inserted in the data deck, an uncluttered master data deck will be produced. This flag is useful when numerous changes have been made to the master deck, or it has been subjected to numerous master overrides.

3.3.5.4 TAPE

A physical or logical tape containing all of the defined FLY plot signals can be generated. These time histories are then available for further signal analysis. This option is activated by a nonzero value for IFFT (RA 1483).

The program computes a counter which controls how often data is saved for plotting. This number is a function of the plot scaling, and computation interval. For a normal run a typical value is every 15th point. Since the data written on tape by this option is also the plotting array, the value of IFFT can be used to specify the data save frequency. If the computed plot frequency is adequate for tape use, then IFFT should be some large number such as 100. If

$$\text{IFFT} < N_{PLT} \text{ (Plot Frequency)},$$

then IFFT will become the counter for data saving. Near equal values will cause mixed results as to the source of timing.

The format of the data tape is shown in Table 3-22. The tape is FORTRAN UNIT 8 written unformatted.

TABLE 3-22. TAPE FORMAT

RECORD	1	CASE PLT INC NPTS	RA(50) ΔT between points # of points
	2	SIGNAL #1	n=1, ---, NPTS
	3	SIGNAL #2	n=1, ---, NPTS
	.	.	.
	.	.	.
	.	.	.
	61	SIGNAL #60	n=1, ---, NPTS

3.3.6 Harmonic Analysis

Harmonic analysis is turned on by RA(1257) = IHAFLG = 1. RA(1262) = HAPLT = 1 supplies time history plots of harmonic analysis parameters at the end of trim. During FLY a subset of the parameters selected for harmonic analysis are plotted. The harmonic analysis flag needs to be on for time histories at the end of trim, but not for the fly plots. The variables that are analyzed are indicated in Table 3-23. Units, directions and axes are listed. Note that DTH1 = RA(1402), DTH2 = RA(1403) and DSTAF = RA(297) are required inputs as explained in the tables.

Harmonic analysis "beats" the signal to be analyzed with harmonics of the rotor rotation frequency. Assuming a function of the form

$$F(\psi_R) = F_o + \sum_{m=1}^{\infty} F_{c,m} \cos (m\psi_R) + \sum_{m=1}^{\infty} F_{s,m} \sin (m\psi_R) \tag{3-23}$$

then

$$F_o = \frac{1}{2\pi} \sum_{o}^{2\pi} F (\psi_R) \, d\psi_R \tag{3-24}$$

TABLE 3-23. HARMONIC ANALYSIS VARIABLES

Symbol FH	Measured Data	Units	Direct Positive	Axis (1)
1	Shaft longitudinal force	lb	Forward	Non-rot.
2	Shaft lateral force	lb	Right	Non-rot.
3	Shaft axial force	lb	Down	Non-rot.
4	Rotor roll moment	in-lb	Right	Non-rot.
5	Rotor pitch moment	in-lb	Nose up	Non-rot.
6	Rotor torque moment	in-lb	Clock-wise	Non-rot.
7	Blade #1 feathering angle	deg	Nose up	Non-rot.
8	Elastic twist at blade tip	deg	Nose up	Shear Center
9	Elastic twist at DTH1 = RA(1402)	deg	Nose up	Shear Center
10	Elastic twist at DTH2 = RA(1403)	deg	Nose up	Shear Center
11	Blade #1 feathering moment	in-lb	Nose down	Shaft
12	Effective sweep at DSTAF = RA(297)	rad	Forward	Feather
13	Effective droop at DSTAF = RA(297)	rad	Down	Feather
14	Blade #1 tip flap displacement	in	Down	Root
15	Shaft longitudinal force, aero only	lb	Forward	Non-rot.
16	Shaft lateral force, aero only	lb	Right	Non-rot.
17	Shaft axial force, aero only	lb	Down	Non-rot.
18	Rotor roll moment, aero only	in-lb	Right	Non-rot.
19	Rotor pitch moment, aero only	in-lb	Nose up	Non-rot.
20	Rotor torque moment, aero only	in-lb	Clock-wise	Non-rot.
21	Blade root span force	lb	Inboard	Root
22	Blade root inplane shear	lb	Forward	Root
23	Blade root flap shear	lb	Downward	Root
24	Blade root roll moment	in-lb	Nose down	Root
25	Blade root flap moment	in-lb	Down	Root
26	Blade root inplane moment	in-lb	Aft	Root
27	Blade root span force, aero only	lb	Inboard	Root
28	Blade root inplane shear, aero only	lb	Forward	Root
29	Blade root flap shear, aero only	lb	Downward	Root
30	Blade root roll moment, aero only	in-lb	Nose down	Root
31	Blade root flap moment, aero only	in-lb	Down	Root
32	Blade root inplane moment, aero only	in-lb	Aft	Root
33	Time component, mode 1, blade 1 * 12	in	Forward	Root
34	Time component, mode 2, blade 1 * 12	in	Down	Root
35	Time component, mode 3, blade 1 * 12	in	Down	Root
36	Generalized force, mode 1, blade 1 * 12	in-lb	Forward	Root
37	Generalized force, mode 2, blade 1 * 12	in-lb	Down	Root
38	Generalized force, mode 3, blade 1 * 12	in-lb	Down	Root

TABLE 3-23 - Continued

Symbol HA-SAVE	Measured Data - Blade Span Variables at Each Sta. (I)	Units	Direct Positive	Axis (1)
1	Span deflection	in	Inboard	Root
2	Inplane deflection	in	Forward	Root
3	Flap deflection	in	Down	Root
4	Angle of attack	deg	Nose up	3/4 Chord
5	Distributed span force, aero only	lb/ft	Inboard	Root
6	Distributed inplane force, aero only	lb/ft	Forward	Root
7	Distributed flap force, aero only	lb/ft	Down	Root
8	Inplane slope	deg	Forward	Root
9	Flap slope	deg	Down	Root
10	Torsion, aero only	in-lb	Nose down	1/4 Chord
11	Span force	lb	Inward	Neutral
12	Inplane shear	lb	Forward	Neutral
13	Flap shear	lb	Down	Neutral
14	Torsion	in-lb	Nose up	Shear center
15	Flap moment	in-lb	Up	Neutral
16	Inplane moment	in-lb	Forward	Neutral

NOTES:

1. The blade element axes listed as 1/4 chord, 3/4 chord, neutral or shear center have axes normal and coincident with the blade element chord line. Some blade variables have components aligned with blade root axes which are normal and coincident with the blade reference axis at station zero on the rotor centerline.

2. The array HASAVE (16,20) is equivalanced to FH; (HASAVE (1,1), FH (39)).

$$F_{c,m} = \frac{1}{\pi}\sum_{0}^{2\pi} F\,(\psi_R)\ \cos\,(m\psi_R)\ d\psi_R \qquad (3\text{-}25)$$

and

$$F_{s,m} = \frac{1}{\pi}\sum_{0}^{2\pi} F\,(\psi_R)\ \sin\,(m\psi_R)\ d\psi_R \qquad (3\text{-}26)$$

where F_o is the mean, $F_{c,m}$ is the cosine component and $F_{s,m}$ is the sine component. The program analyzes up to the sixth harmonic, and operates during the last revolution in TRIM. The mean, sine and cosine components, plus their respective vector representation are tabulated. The phase is the angle from zero azimuth where blade 1 is in aft position to the first positive maximum for the harmonic in question.

The harmonic analysis made on blade loads requires integration from the tip to the blade station in question. Thus, in preparing for harmonic analysis the program turns around the integration. Typically,

$$F(\ell)_{X_{BLE,\ BL1}} = F_{XO_{BL1}} - \sum_{i=1}^{\ell} F(i)_{X_{BLE,BL1}} \qquad (3\text{-}27)$$

where $F_{XO_{BL1}}$ is the blade root span force and $F(i)_{X_{BLE,BL1}}$ is the value integrated from the root to the station in question, a value saved during the root to tip integration. The quantity on the left-hand side of the equation is then the load integrated from the tip. Next the loads are transferred from points lying on the blade root axes to points lying on the blade axes, which is the inverse process of that given in Volume I, Section 6.6.4:

$$\begin{Bmatrix} F(\ell)_{X_{BLE}} \\ F(\ell)_{Y_{BLF}} \\ F(\ell)_{Z_{BLE}} \end{Bmatrix}_{BL1E} = \begin{Bmatrix} F(\ell)_{X_{BLE}} \\ F(\ell)_{Y_{BLE}} \\ F(\ell)_{Z_{BLE}} \end{Bmatrix}_{BL1} \qquad (3\text{-}28)$$

$$
\begin{Bmatrix} M(\ell)_{X_{BLE}} \\ M(\ell)_{Y_{BLE}} \\ M(\ell)_{Z_{BLE}} \end{Bmatrix}_{BL1E} = \begin{Bmatrix} M(\ell)_{X_{BLE}} \\ M(\ell)_{Y_{BLE}} \\ M(\ell)_{Z_{BLE}} \end{Bmatrix}_{BL1}
$$

$$
+ \begin{bmatrix} 0 & Z(\ell)_{BLE} & -Y(\ell)_{BLE} \\ -Z(\ell)_{BLE} & 0 & X(\ell)_{BLE} \\ Y(\ell)_{BLE} & -X(\ell)_{BLE} & 0 \end{bmatrix}_{BL1} \begin{Bmatrix} F(\ell)_{X_{BLE}} \\ F(\ell)_{Y_{BLE}} \\ F(\ell)_{Z_{BLE}} \end{Bmatrix}_{BL1} \tag{3-29}
$$

The notation BL1E indicates an axis system parallel to BL1 axes, but with origin on the blade line of interest; this blade line being the neutral axis, the shear center axis or whatever is appropriate for the blade variable. Finally, a rotation finds the loads in the blade element axes:

$$
\begin{Bmatrix} F(\ell)_{X_{BLE}} \\ F(\ell)_{Y_{BLE}} \\ F(\ell)_{Z_{BLE}} \end{Bmatrix}_{BLE} = \begin{bmatrix} T_{BLn-BLE} \end{bmatrix} \begin{Bmatrix} F(\ell)_{X_{BLE}} \\ F(\ell)_{Y_{BLE}} \\ F(\ell)_{Z_{BLE}} \end{Bmatrix}_{BL1E} \tag{3-30}
$$

and

$$\begin{Bmatrix} M(\ell)_{X_{BLE}} \\ M(\ell)_{Y_{BLE}} \\ M(\ell)_{Z_{BLE}} \end{Bmatrix}_{BLE} = \left[T_{BLn-BLE}\right] \begin{Bmatrix} M(\ell)_{X_{BLE}} \\ M(\ell)_{Y_{BLE}} \\ M(\ell)_{Z_{BLE}} \end{Bmatrix}_{BL1E} \tag{3-31}$$

3.3.7 Main Rotor Blade

3.3.7.1 Geometry

The program takes a straight line radiating from the shaft at the hub center and builds up the blade reference line which is taken to pass through the quarter chord line. REXOR blade station locations are in the array, SX. Do not use more than 20 stations. The first blade station, SX(1), is a dummy and zero modal data can be provided. SX(2) should be at the inboard edge of the movable hub. RA(500 + NRAD) = R = RA(81). The blade station for starting the blade integration, RA(500) = KSTART, is usually set at 2, and the station interval increment, RA(499) = NINC, set at 1.

At each spanwise station the chordwise location of a number of blade element properties are specified. These are the element center of gravity, the neutral axis, and the shear center. Note again that these data are specified with respect to the quarter-chord line. The basic reference data is summarized in Table 3-24.

A number of other items are tabulated at blade stations such as mass, torsion, and modal data. These will be presented in their respective sections.

Geometric twist, θ_{TW}, and coning β_O, are additional inputs. Coning is assumed to start at the shaft center line. Additional inputs include blade droop angle relative to the precone angle, γ, blade sweep, τ_O, and offsets Y_{jog} and Z_{jog}. All of these design parameters are measured at a specified blade location termed STA70. STA70 is an input (feet), and does not necessarily correspond to a station location. This location is often the location at which the movable hub attaches to the blade proper.

The feather bearing locations are described by two inputs. These are the location of an inboard bearing HUBL(1) and the distance between

TABLE 3-24. BLADE STATION REFERENCE DIMENSIONS		
Input Quantity		Address
NRAD	No. of blade stations	498
NINC	Station interval	499
KSTART	Starting station	500
SX	Blade station locations, ft	501-540
SY	Blade element c.g. location relative to the quarter chord	601-640
YNA	Location of neutral axis relative to quarter chord	1521-1540
YCS	Location of shear center relative to quarter chord	1421-1460

bearings, HUBL(2). Both locations must be specified to permit computing the feather axis slope from the bearing displacements. The program internally computes the offset of the bearings above and below the blade reference axis on the assumption the feather axis crosses the blade axis midway between bearings. The feather axis geometric coning is specified as BFAS. An additional offset, DELZOB, can be specified for the outboard bearing. Care should be exercised as the geometric coning the program uses will be increased above that specified by BFAS to account for DELZOB.

Finally, the blade radius, R, and chord, CORD, a constant over the blade, are required. All of these geometric inputs are fully discussed in Volume I in Section 5.5.5. They are summarized in Table 3-25.

The blade stations for the inboard and outboard ends of the tension-torsion pack are built in the program at 12.03 in. and 30.43 in. The ends are 0.030 in. and 0.366 in. above the blade reference line, respectively. The tension torsion pack is the blade centrifugal force restraint.

3.3.7.2 Blade Bending Modes and Related Data

Each blade bending mode has a chordwise and flapwise displacement component, but not an elastic twist component. Cases are usually run with three bending modes, but two can be used. Torsion and pitch horn bending are treated separately (see Sections 3.3.7.4 and 3.3.7.5 for a discussion of inputs).

TABLE 3-25. BLADE ANGLES, OFFSETS, AND DIMENSIONS			
Input Quantity			Address
R	R	Blade radius, ft	81
θ_1	THI	Geometric twist, radians	85
c	CORD	Main rotor blade chord, ft	110
ℓ_{IB}	HUBL(1)	Inboard bearing location, ft	128
ℓ_B	HUBL(2)	Distance between bearings, ft	129
β_o	BETA	Blade cone angle, deg	1266
τ_o	TAU	Blade sweep, deg	1267
γ	GAMMA	Blade droop, deg	1268
β_{FA}	BFAS	Blade bearing cone angle	1270
ΔZ_{OB}	DELSOB	Outboard bearing offset adjustment	1479
Y_{jog}	YJOG	Blade chordwise offset, ft	1481
Z_{jog}	ZJOG	Blade flapwise offset, ft	1482
X_{SW}	STA70	Location where sweep and droop begin	2570

By convention, mode 1 is taken to be the first inplane, mode 2 the 1st flap, and mode 3 the 2nd flap. Each mode is presented to the program in an array where the row index (first) corresponds to blade station and the column index (second) identifies which displacement or slope. For instance, the inplane mode chordwise displacement at station one is BMS1I(1,1), the flapwise displacement is BMS1I(1,2), the chordwise and flapwise slopes are BMS1I(1,3) and BMS1I(1,4). The mode shapes are defined by completing the first index for the specified blade stations. A normalization based on the tip chord or flap displacement, whichever is greater, has been frequently used. Any normalization could be used but output labels are based on unit tip values.

The chordwise and flapwise components are equal to the inplane and outplane displacements at a reference feather angle given by PHIREF. The program rotates the modes with the feather angle so that the bending components are in axes fixed to the blade. A rotor speed, Ω, is also specified when the mode shapes are computed. The rotor speed for

a given case should be reasonably close to this specified speed. The rotor speed input location, RA(52), has already been discussed.

All modes are nominally with the chordwise/displacement positive forward and the flapwise displacement positive down. The program reverses the sign on the flapwise component internally to match BLn axes convention.

Modal data is also needed at the feather bearing stations. For mode 1, FBL1I(1,1) is the chordwise displacement and FBL1I(2,1) is the flapwise displacement at the inboard bearing station. FBL1I(1,2) and FBL1I(2,2) are the corresponding values for the outboard bearing station. Mode 2 and 3 bearing deflections are similarly specified.

Additional modal data is required when the program is computing the control configuration which features direct flap feedback to an isolated control gyro. The outplane displacement is ZRMI(1) for mode 1, ZRMI(2) for mode 2, and ZRMI(3) for mode 3. In a similar manner, ZRMPI(I) describes the outplane slope components. The program does not use the inplane displacement and slope components to describe the flap feedback.

The bending modes have a feather angle component given by the coupling factors C1I1, C1F1, and C2F1 for modes 1, 2, and 3. C1I1 is the radians of feather angle per radian of chordwise feather axis slope deflection. C1F1 and C2F1 are per radian of flapwise feather bearing slope deflection for modes 2 and 3. The coupling factors are defined for the condition that the end of the pitch horn where it attaches to the pitch link remains fixed in space when the blade bends. The pitch horn is also assumed not to bend, the bending being handled by separate programming.

The modal inputs discussed thus far are summarized in Table 3-26.

A detailed tension torsion pack simulation is optional. If desired, it is activated by a flag TTFLAG. Note, however, that tension torsion pack station locations are currently built into the program and represent Lockheed Cheyenne data only. Modal data is required if this option is used. Inputs are summarized in Table 3-27.

The program computes the centrifugal stiffness by adding the centrifugal acceleration in with the other accelerations when the generalized mode force is found. Only the structural stiffness is required as input. This is presented as a 3 by 3 matrix, BLADK. Consult Volume I, Section 6.6.4 for a formulation for this symmetric spring matrix. The off-diagonal terms cross couple modes, as would be expected even for orthogonal modes. The units given in the input tabulation for the spring and other modal constants assume the modal displacement components are given in feet and the slope in radians. The modal degrees of freedom have units of time. Units, however, are

TABLE 3-26. BLADE MODAL DATA

Input Quantity		Address
BMS1I(1,1)	Y displacement, inplane mode	761-800
BMS1I(1,2)	Z displacement, inplane mode	801-840
BMS1I(1,3)	dY/dS, inplane mode	841-880
BMS1I(1,4)	dZ/dS, inplane mode	881-920
BMS1F(1,1)	Y displacement, 1st flap mode	921-960
BMS1F(1,2)	Z displacement, 1st flap mode	961-1000
BMS1F(1,3)	dY/dS , 1st flap mode	1001-1040
BMS1F(1,4)	dZ/dS , 1st flap mode	1041-1080
BMS2F(1,1)	Y displacement, 2nd flap	1081-1120
BMS2F(1,2)	Z displacement, 2nd flap	1121-1160
BMS2F(1,3)	dY/dS , 2nd flap	1161-1200
BMS2F(1,4)	dZ/dS , 2nd flap	1201-1240
PHIREF	Blade reference feather angle, deg	1269
	Feather Bearing Inplane Mode:	
FBL1I(1,1)	Inboard Y displacement	275
(2,1)	Z	276
(1,2)	Outboard Y	277
(2,2)	Z	278
	Feather Bearing 1st Flap Mode:	
FBL1F(1,1)	Inboard Y displacement	279
(2,1)	Z	280
(1,2)	Outboard Y	281
(2,2)	Z	282

TABLE 3-26 - Continued		
Input Quantity		Address
	Feather Bearing 2nd Flap Mode:	
FBL2F(1,1)	Inboard Y displacement	283
(2,1)	Z	284
(1,2)	Outboard Y	285
(2,2)	Z	286
	Outplane Displacement of Feedback Mount:	
ZRMI(1)	Blade mode 1	2522
(2)	2	2523
(3)	3	2524
	Outplane Slope of Feedback Mount:	
ZRMPI(1)	Blade mode 1	2528
(2)	2	2529
(3)	3	2530
C1I1	Inplane to feather coupling factor	145
C1F1	1st flap to feather coupling factor	146
C1F2	2nd flap to feather coupling factor	148

TABLE 3-27. TENSION-TORSION PACK DATA		
	Input Quantity	Address
TTFLAG	Flag 0 = OFF 1 = ON	1404
	Inplane displacement, inboard end:	
YIV1	mode 1	1409
YIV2	2	1410
YIV3	3	1411
	Outplane displacement, inboard end:	
ZIV1	mode 1	1412
ZIV2	2	1413
ZIV3	3	1414
	Inplane displacement, outboard end:	
YOV1	mode 1	1415
YOV2	2	1416
YOV3	3	1417
	Outplane displacement, outboard end:	
ZOV1	mode 1	1418
ZOV2	2	1419
ZOV3	3	1420

not indicated for the modal components to indicate these can be arbitrarily normalized. Space is provided in the inputs starting at RA(82) = OB(1) for the modal natural frequencies. These are not necessary to normal program operation.

The structural damping in each mode is the same. Its contribution to the generalized force is

$$\frac{\partial B}{\partial \dot{A}_{mn}} = c \sum_{j=1}^{3} K_{mj} \dot{A}_{jn} \qquad (3\text{-}32)$$

for mode m, blade n. The damping constant can be interpreted as

$$c = 2 \zeta \omega_o$$

where ζ is the damping ratio at the natural frequency ω_O of interest. Three inputs control the damping level c: CTRIM, CFLY and CZERO. The program linearily interpolates between CZERO and CTRIM for the first second in TRIM. CTRIM should have a value equal to CFLY or close to it. CZERO is set high, a value of 0.0156 being typical, to quiet the inplane mode promptly. This mode typically has low damping and would otherwise take an excessive time in TRIM to reach a steady state. The damping function is shown in Figure 3-10.

If an external lead-lag damper exists, its damping constant is CLAG. The usual linear damper is modeled as a rotary equivalent damper acting about the real or virtual lead-lag hinge. Currently REXOR approximates the lead-lag hinge to be centered between the feather bearings in order to use the feather axis slope velocity, $\dot{Y}'_{FA}$, available for this location. The damper produces a moment proportional to the feather axis slope velocity.

The REXOR blade modal and external (lead-lag) damper data is summarized in Table 3-28.

3.3.7.3 Blade Aerodynamics

A number of blade aerodynamic data representations are available in REXOR, and these are discussed in the following paragraphs. All the representations use a blade root cutout (drag only, no lift or moment) identified as CUTOUT = RA(2688).

If linear aerodynamic is sufficient, then only the inputs of Table 3-29 are required.

Nonlinear aerodynamics is primarily determined by built-in tables. There are two tabular procedures available. One is known as the "seven table lookup" which provides

$$C_L = C_L\ (\alpha,\ M,\ t/c,\ C_{L_i}) \qquad (3\text{-}33)$$

$$C_D = C_D\ (\alpha,\ M,\ t/c,\ C_{L_i}) \qquad (3\text{-}34)$$

and a choice of C_M tables. The other, called "fast aero," provides a specialized airfoil which is determined by a highly efficient set of interpolating routines. The flag ILOOK determines whether "seven table lookup" is used or "fast aero."

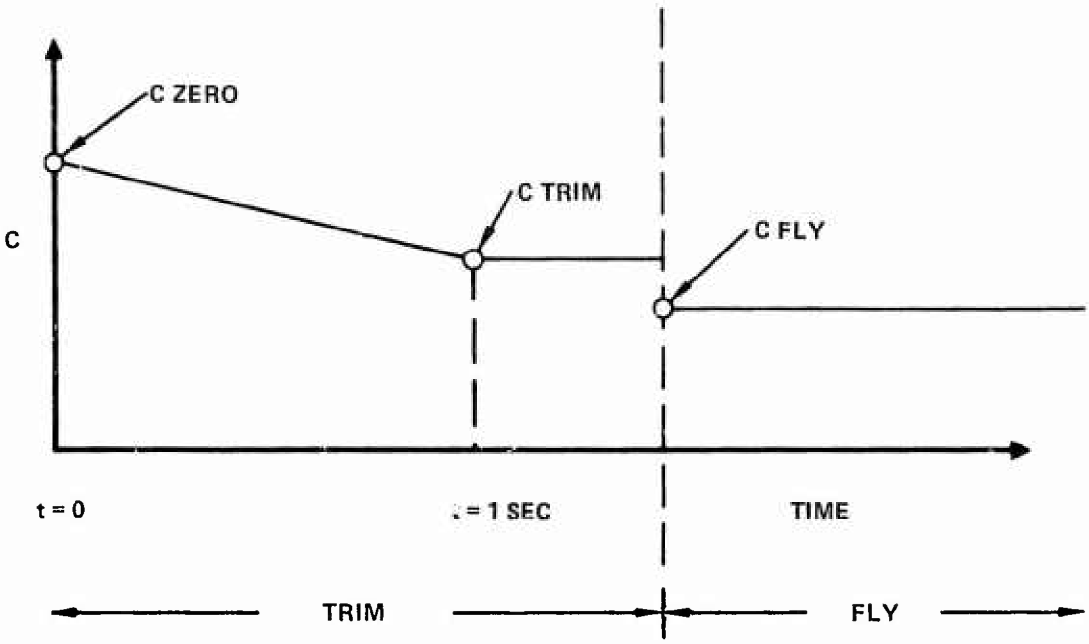


Figure 3-10. TRIM-FLY Damping Function

TABLE 3-28. STRUCTURAL AND DAMPING COEFFICIENT DATA

Input Quantity		Address
BLADK(3,3)	Blade stiffness matrix	1241-1249
CZERO	Blade modal damping at trim initialization	1252
CTRIM	Blade damping after 1 sec of TRIM	1250
CFLY	Fly modal damping	1251
CLAG	Inplane lag damper constant	371

TABLE 3-29. LINEAR AERODYNAMICS

Input Quantity		Address
NSDATA	BLADE AERO FLAG set = 1 for linear aerodynamics	44
SMALLA	Blade lift slope, $dC_L/d\alpha$	111
DELTO	Minimum drag coefficient, C_{D_o} at $\alpha = 0$	112
DELT2	$d^2C_D/d\alpha^2$	113

Once the table values are determined, an increment to the drag coefficent can be added at every station by the input DELCD. Further, an increment, DCMR, to the pitching moment coefficient resulting from a trailing-edge tab can be added between the inboard and outboard ends of that tab as specified by the inputs KT1 and KTO. DCMR is added when

$$KT1 \leq K \leq KTO \tag{3-35}$$

where K is the REXOR station index.

In addition to the root cutout, REXOR also computes only a drag for the outboard blade segment. Thus, a 'tip loss' factor can be

implicitly applied by proper choice of the REXOR station just inboard of the tip. The relationship is

$$SX\ (NRAD-1) = R*(2B-1) \tag{3-36}$$

where R is the blade radius and B is the tip loss factor.

Returning to aerodynamic table lookup, if ILOOK = 1, then the "seven table lookup" option is in effect. Thickness ratio, t/c, and design lift coefficient, C_{L_i}, must be input as a function of normalized blade location, x_n, where $0 \le x_n \le 1$. The desired C_M table is determined by the input value of IFOIL where IFOIL = 0 gives the NACA 23008 airfoil and IFOIL = 1 results in the NACA type 0012 table.

If ILOOK = 0, then the fast aero tables are used. These special tables are currently fitted with the Cheyenne helicopter blade data. A Cheyenne phase 2 or phase 3 blade may be modeled. A phase 2 blade is activated by setting IBLADE = 2. Here an increment is added to the 23008 C_M table value that is a function of angle of attack and thickness ratio.

$$C_M = C_M\ (\text{table}) - 0.34 \cdot t/c_1 \cdot \alpha \tag{3-37}$$

where

$$t/c_1 = t/c - 0.08$$

and

$$\alpha_1 = (30 - \alpha)/14 \le 1.$$

For a phase 3 blade, determined by setting IBLADE = 0, a simple increment may be added.

$$C_M = C_M\ (\text{table}) + \text{DCMR1 (input)} \tag{3-38}$$

The user should be aware that for either a phase 2 or 3 blade the angle of attack for the pitching moment tables is modified:

$$\alpha = \alpha + K_\alpha * \alpha_1 * (M - 0.7) * (t/c - 0.08) \qquad (3\text{-}39)$$

where K_α is 400 if $t/c < 0.08$ or is 243 otherwise. The angle of attack is unmodified for Mach = $M > 0.7$.

Under the special table option a further refinement may be made known as dynamic stall. Dynamic stall is triggered by setting ISTALL = 1. A reference angle factor, FACTM, is required. A description of its nature is found in Volume I, Section 7.2.3.4.2. Nonlinear aerodynamic inputs are summarized in Table 3-30.

TABLE 3-30. NONLINEAR BLADE AERO DATA

Input Quantity		Address
DELCD	Blade element incremental C_D	1264
KTI	Inbound blade tab station number	1345
KTO	Outboard blade tab station number	1346
DCMR	Incremental C_M for blade tab	1256
ILOOK	Aero table flag	2689
For ILOOK = 1 only:		
IFOIL	C_M table flag	2690
XNTAB	Normalized blade location table	2691-2695
TCTAB	Thickness ratio table	2696-2700
CLTAB	Design lift coefficient table	2701-2705
For ILOOK = 0 only:		
IBLADE	Cheyenne blade option flag = 2 phase 2 = 0 phase 3	1300
DCMR1	Incremental C_M for phase 3 blade	1347
ISTALL	Dynamic stall simulation flag	2555
FACTM	Reference angle factor	2559

3.3.7.4 Pitch Horn Bending

The program can be directed to simulate quasi-static or dynamic pitch horn bending. If no bending is desired, then only the pitch horn length is required, E (RA 136). If KPH is nonzero, then quasi-static bending is assumed. The input KPH also serves as the pitch horn spring in foot-pounds of feathering moment per radian of elastic feathering. A time constant, TPH, is also required. Since a first order lag is simulating the dynamics, the time constant could be roughly the reciprocal of the natural frequency of the pitch horn bending mode.

Dynamic pitch horn bending is activated by setting IPHORN = 1. The dynamic pitch horn should not be used with either quasi-static pitch horn bending or dynamic torsion. The pitch horn degrees of freedom for each blade are independent for the normal swashplate configuration. When the IAMCS flag specifies the control configuration with an isolated gyro, a reactionless pitch horn is obtained. The cyclic and collective pitch horn springs are taken to be combined with the swashplate springs. Hence, only one of the pitch horn degrees of freedom will have non-zero value and it will indicate the reactionless component. See the subheading BMOVE of Volume II, Section 1.3. The dynamic pitch horn requires a spring, AKPH, and a partial, ZBPH. If ZBPH = 1, the amount the end of the pitch horn displaces will be feet per radian of elastic feathering. If ZBPH = E = RA(136), the pitch horn displacement is in terms of the actual feathering displacements. Therefore, no units are given for ZBPH. The units listed in the input tabulation for AKPH assumes the ZBPH is identically one. The pitch horn bending inputs are given in Table 3-31.

TABLE 3-31. PITCH HORN BENDING INPUTS

Input Quantity		Address
E	Pitch horn length	136
KPH	Quasi-static pitch horn spring	1487
TPH	Quasi-static pitch horn time constant	1488
IPHORN	Dynamic pitch horn flag	1480
ZBPH	Pitch horn partial	1477
AKPH	Pitch horn spring	1478

3.3.7.5 Torsion

Quasi-static or dynamic torsion capabilities are available. Quasi-static torsion is signaled by the input flag TORFLG. Other inputs include a time constant TCT, and DSOGJ which is the reciprocal of the torsional stiffness. The time constant, TCT, is for a first-order simulation of the torsion dynamics. To alleviate numerical difficulties, however, the elastic twist velocity is not used in the computations, only the displacements. Nevertheless, a value for the time constant roughly equal to the reciprocal of the natural frequency of the torsion mode is appropriate. The required quantities are presented in Table 3-32.

Dynamic torsion is activated by setting IDYN = 1. Dynamic torsion (an uncoupled mode) cannot be used at the same time as dynamic pitch horn bending. This option is also not compatible with the direct flap feedback gyro control system which internally specifies a reactionless pitch horn bending. For uncoupled torsion, a mode shape starting at RA(2871) = PPTOR(1) is required. As usual, any normalization will work, but for output consistency one radian nose up twist at the blade tip is suitable. The quantities needed are reviewed in Table 3-33.

TABLE 3-32. QUASI-STATIC TORSION

Input Quantity		Address
TORFLG	Quasi-static torsion flag	1497
TCT	Quasi-static time constant	1401
DSOGJ	Reciprocal of torsional stiffness at every REXOR station	1361-1400

TABLE 3-33. DYNAMIC TORSION INPUTS

Input Quantity		Address
IDYN	Dynamic torsion flag	2870
PPTOR	Torsion mode shape at each REXOR station	2871-2890

3.3.7.6 Feather Bearing Loads

Feather bearings are modeled in REXOR having the properties of a torsional spring rate, friction, and damping. The spring can be due to the bearings or from some other physical source such as the tension-torsion pack, if used. The spring rate is TXS.

Bearing friction can be modeled as stiction or viscous friction, or a combination thereof. Figure 3-11 illustrates the nature of friction function.

Stiction is modeled if RLF is a small number (not zero) and FCF is the stiction load. If only viscous friction is desired without a stiction limit, then RLF must be much larger than the normal range of the velocity, and the ratio FCF/RLF determines the viscous damping coefficient.

Viscous damping can also be supplied via the input CFB. The inputs are summarized below in Table 3-34.

3.3.8 Weight and Balance

The total mass of the vehicle is the sum of mass of its parts. The required inputs are specified in Table 3-35.

The program integrates the blade distributed mass and then adds up all the blades to find the rotor mass. The blade mass is defined as all the masses that can be feathered. The remainder of the rotating masses are included in the hub mass.

The center of gravity of the fuselage from the fuselage reference axis origin is specified by XFBAR, YFBAR, and ZFBAR. The hub center of gravity is assumed at the hub axis origin and no input is required. The swashplate center of gravity, ZGS, is the height of the swashplate center of gravity above the hub axis origin when the main rotor collective is at its trimmed value. The program computes the location of the blade masses as the blade bends and feathers. It assumes the blade masses are on the blade center-of-gravity axis defined with respect to the blade quarter chord axis. The location of the c.g. line was discussed earlier.

The moments and products of inertia required are presented in Table 3-36.

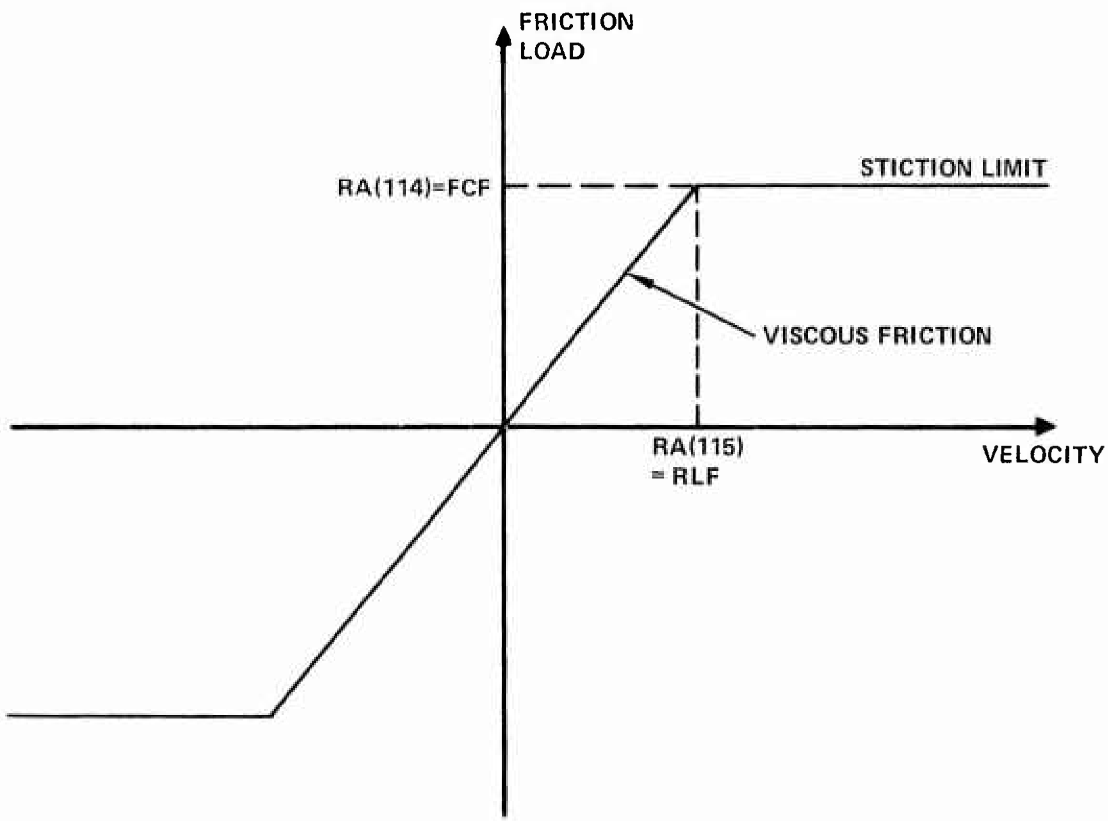


Figure 3-11. Feather Bearing Friction

	TABLE 3-34. FEATHER BEARING LOADS	
	Input Quantity	Address
TXS	Feather spring	294
CFB	Feathering viscous friction	1485
FCF	Feather friction	114
RLF	Feather stiction break point	115

	TABLE 3-35. MASS DATA TABLE	
	Input Quantity	Address
FMASS	Fuselage, including wings and tail surfaces, tail rotor, propeller, and engine	91
HMASS	Hub	366
GMASS	Swashplate	139
QM(1)-QM(40)	Blade distribution mass at each REXOR station	541-580

The control gyro inertia is described in Section 3.3.15. It is too small to affect principal axis motions.

3.3.9 Airframe

3.3.9.1 Geometry

The geometry of the airframe includes the lengths to the various configuration fixed surfaces. The inputs involved are SLHS, SLVS and HVS. See below for wing area and chord. The program assumes all the elements, both rotors as well as fixed surfaces, have reference axes parallel to the fuselage reference axes, and no Euler angles (including incidence angles) are to be described. Also the fuselage vertical axis lies along the shaft centerline (no shaft bending). Further, the wing quarter-chord line is assumed to intercept the fuselage reference vertical axis. See Table 3-37.

TABLE 3-36. INERTIA AND C.G. DATA

Input Quantity		Address
XFBAR YFBAR ZFBAR	Fuselage c.g. location relative to the hub	372 373 374
IXXF IYYF IZZF IXYF IXZF IYZF	Inertia terms for the fuselage wing and tail surfaces	1461 1462 1463 1464 1465 1466
IZZH	Hub	1468
IZZG IXXG	Swashplate	118 361
IXXPRO	Propeller	1470
IXXENG	Engine	1471
IYYTR	Tail rotor	1472
BI	Blade moment of inertia about blade center of gravity axis. Inertia is distributed with per ft units at each REXOR station	1301-1340
ZGS	Height of swashplate c.g. above hub axis for nominal collective	1469

TABLE 3-37. AIRFRAME GEOMETRY

Input Quantity		Address
SLHS	Distance from fuselage axis to horizontal tail	101
SLVS	Distance from fuselage axis to vertical tail, + aft	102
HVS	Distance from fuselage axis to vertical tail, + up	103

3.3.9.2 Aerodynamics

The fuselage here is taken to include the wings, if any, plus vertical and horizontal tail surfaces. All these surfaces are fixed and no aileron, elevator, etc., are available. The aerodynamics are described by a table of values for the drag, lift and moment at all angles of attack and a matrix of derivatives expressing the sideslip characteristics and the damping due to the wing and tail surfaces. The aerodynamic formulation is given in Volume I, Section 7.4.

The static loads are given by RA(2601) = ALFA(1), RA(2621) = CL(1), RA(2641) = CM(1), RA(2661) = CD(1) and following entries which relate the lift, drag and pitching moment coefficients to the angle of attack. A maximum of twenty angle-of-attack points are allowed which should cover the total range of values from -180 to +180 deg. These coefficients can be taken directly from wind tunnel tests of a model without the blades. The loads are sized by the wing area and the wing chord length, RA(2681) = AWING and RA(2682) = CWING. For a wingless configuration dummy values of 1.0 and 0.1 can be used. CWING should be small to reduce a wing damping term to a negligible size.

The fuselage matrix RA(441) = FNM(1,1), RA(442) = FNM(2,1) and following entries allow for loads due to asymmetry, linear and quadratic sideslip variations, wing damping in roll, plus vertical and horizontal tail damping. The matrix is a set of derivatives relating the fuselage forces and moments with the velocity terms. The first subscript in FNM refers to the loads and the second to the velocity. The terms are developed in Volume I, Section 7.4 and repeated here.

$$\begin{Bmatrix} F_X \\ F_Y \\ F_Z \\ M_X \\ M_Y \\ M_Z \end{Bmatrix}_{FW} = \begin{bmatrix} F_{NM}(1,1) & (1,2) & \ldots & (1,6) \\ (2,1) & & & \\ \cdot & & & \\ \cdot & & & \\ \cdot & & & \\ (6,1) & & & (6,6) \end{bmatrix} \begin{Bmatrix} u_F{}^2 \\ v_F{}^2 \\ u_F \; v_F \\ u_F \; p_F \\ u_F \; \Delta w_{HT} \\ u_F \; \Delta v_{HT} \end{Bmatrix} \qquad (3\text{-}40)$$

The loads are in wind axes, the velocities in fuselage reference axes. The X axis points forward, the Y rightward and the Z axis downwards. The first column represents loads due to airframe

asymmetry such as those due to different incidence on the left and right wing panels. The second and third columns describe the static sideslip characteristics with both a linear and quadratic variation allowed where:

$$u_F \, v_F \simeq u_F^{\,2} \, \beta_F \tag{3-41}$$

and

$$v_F^{\,2} \simeq u_F^{\,2} \, \beta_F^{\,2} \tag{3-42}$$

Assuming the matrix elements are found for moderate angles of side-slip β_F. The fourth column is zero unless the wing roll damping derivative FNM(4,4) is significant. Up to this point the matrix columns refer to the airframe complete with wing and tail surfaces. The fifth and sixth columns relate to the lift curves slopes C_{L_α} and C_{Y_α} of the horizontal and vertical tail surfaces such that

$$\text{FNM}(3,5) = -\frac{1}{2} \rho_o S_{HT} C_{L_\alpha} \tag{3-43}$$

and

$$\text{FNM}(2,6) = -\frac{1}{2} \rho_o S_{VT} C_{Y_\beta} \tag{3-44}$$

where ρ_o is the sea level air density of .002378 slugs/ft^3 and S is a tail surface area. The matrix elements are evaluated at sea level and the program ratios the fuselage aerodynamic load by the density ratio at altitude. The pitching and rolling moment derivatives from the tail are obtained for the force derivatives times the appropriate tail length or height:

$$\text{FNM}(5,5) = \ell_{HT} * \text{FNM}(3,5) \tag{3-45}$$

$$\text{FNM}(4,6) = -h_{VT} * \text{FNM}(2,6) \tag{3-46}$$

and

$$\text{FNM}(6,6) = -\ell_{VT} * \text{FNM}(2,6) \tag{3-47}$$

The equation for FNM(4,6) is only a rough approximation to the tail fin dihedral effect. A variation with angle of attack is not allowed by the program.

The aerodynamic inputs required for the airframe are summarized in Table 3-38.

3.3.10 Tail Rotor

Only aerodynamic inputs are described here. Inertia, control and downwash data are described in other sections on the respective topic. The aerodynamic loads are presently formulated for use with a tail rotor whose upper blade moves aft. The required data is annotated and summarized in Table 3-39.

3.3.11 Propeller

The propeller thrust and torque is given by bivariant tables in blade angle and advance ratio as shown in Volume I, Section 7.6. IXYPRO = PROFLG turns the propeller on. The propeller thrust is parallel to the fuselage longitudinal axis and offset laterally by YP. Other inputs relate the non-dimensional table values with the dimensional quantities needed by the program:

TABLE 3-38. AIRFRAME AERODYNAMICS

Input Quantity		Address
ALFA	Angle-of-attack table, deg	2601-2620
C_L	Airframe C_L	2621-2640
C_M	Airframe C_M	2641-2660
C_D	Airframe C_D	2661-2680
AWING	Wing area, ft^2	2681
CWING	Wing chord, ft	2682
FMN	Body airload coefficient matrix	441-476

	TABLE 3-39. TAIL ROTOR DATA	
	Input Quantity	Address
SLTR	Distance from fuselage axis to tail rotor, + aft	98
HTR	Height of tail rotor above fuselage axis, + up	1348
YTR	Tail rotor lateral offset from fuselage axis, + RT	274
CONK	Tail rotor pitch-flap coupling, δ_3	1253
AOTR	Tail rotor blade area	2683
RTR	Tail rotor radius	2684
A	Tail rotor lift slope, $dC_L/d\alpha$	2685
B	Tail rotor tip loss factor	2686

$$J = \text{Advance ratio} = \text{PARCON}/(\dot{\psi}_R - r_F/G_P) \quad (3\text{-}48)$$

$$T_P = \text{Thrust} = C_T \, \sigma \, \text{THRCON} \, (\dot{\psi}_R - r_F/G_P)^2 \quad (3\text{-}49)$$

$$Q_P = \text{Torque} = C_P \, \sigma \, \text{TORCON} \, (\dot{\psi}_R - r_F/G_F)^2/2\pi \quad (3\text{-}50)$$

where

C_T and C_P are the thrust and power coefficients from the tables.

R_P is the propeller radius.

ρ_o is the sea level density

σ is the density ratio at altitude

U_P is the propeller forward velocity

G_P is the rotor to prop gear ratio

$\dot{\psi}_R$ is the rotor speed

r_F is the fuselage roll rate

$$THRCON = \rho_o (2\ R_P)^5\ (G_P/2\pi)^2$$

$$TORCON = \rho_o (2\ R_P)^4\ (G_P/2\ )^2$$

$$PARCON = 4\ \pi\ U_P\ R_P/G_P$$

The propeller inputs are tabulated in Table 3-40.

3.3.12 Hub

The mass properties are found in weight and balance, Section 3.3.8. The hub is located a distance RA(96) = HF above the fuselage reference. It is at the point where the blade cone line intercepts the shaft.

3.3.13 Engine

The inputs to be discussed relate to the engine torque and the fuel control. Inertial data is discussed in Section 3.3.8. The engine on flag is RA(45) = CRSFG = 1. The engine schematic is given in Volume I, Section 6.12, Figure 6-8.

TABLE 3-40. PROPELLER INPUTS

Input Quantity		Address
[IXXPRO PROFLG]	Propeller polar inertia and operation flag	1470
YP	Propeller lateral offset	1349
THRCON	Propeller thrust coefficient	1350
TORCON	Propeller torque coefficient	1351
PARCON	Propeller advance ratio coefficient	1352

Note the schematic gives engine speed, but for convenience the rotor speed is used as reference. The constants should be calculated with this in mind. The engine torque is bounded by zero and RA(1484) = ENGHPX. Drive train dynamics are not modeled. The engine inputs are summarized in Table 3-41.

The propeller, engine, and tail rotor are assumed aligned with the fuselage reference axes which are parallel to the main rotor hub axes. Gear ratios are needed, GRPRO, GRENG, and GRTR. The gear ratios are positive if the rotors rotate as follows: main rotor, hub and swashplate are counterclockwise looking down, the propeller and engine are counterclockwise looking forward, and the tail rotor clockwise looking rightward.

3.3.14 Swashplate and Feather-Flap Feedback Control Gyro

The swashplate programming is suitable for modeling a number of control system types:

1. Locked swashplate

2. Normal "hard" swashplate

TABLE 3-41. ENGINE INPUTS

Input Quantity		Address
PQENG	Torque to generator speed ratio, $\partial M_{ENG}/\partial \Psi_{GEN}$	591
PQEOM	Torque to rotor speed ratio, $\partial M_{ENG}/\partial \Psi_{R}$	592
K1PRM	Acceleration feedback gain, k_{R1}	593
K2PRM	Speed feedback gain, k_{R2}	594
TAUG	Gas generator time constant, τ_{GEN}	595
GRPRO	Gear ratio propeller	1473
GRENG	Gear ratio engine	1474
GRTR	Gear ratio tail rotor	1475
ENGHPX	Maximum horsepower	1481

3. Lockheed's original control system with feather-flap feedback control gyro (ICS system)

4. Lockheed's advanced control system with direct-flap feedback control gyro (AMCS system)

Flags are required for two of the four variants: RA(42) = HARDSP = 1 for a locked swashplate, and RA(490) = IAMCS = 1 for the AMCS system. Variants 2 and 3 can both be modeled with the same set of equations.

The Lockheed AMCS system featured a direct-flap feedback control gyro. In this system the pilot does not control the swashplate directly, instead he torques a small control gyro which in turn slaves the swashplate. For such a system the user must consider the inputs described in the section relating to the control gyro (3.3.15), otherwise that section can be skipped.

The original Lockheed control system featured a feather-flap feedback control gyro mounted above the main rotor. The external gyro in this system rotated and tilted in concert with the swashplate. The external gyro and swashplate is identified as equivalent to a swashplate suspended on "soft" cyclic springs which is subject to pilot control spring forces. It contrasts to the usual "hard" swashplate with stiff structural springs and low inertia.

Table 3-42 lists the inputs to be considered with an operative swashplate. Note that with the present programming, the swashplate slop is unavailable for non-AMCS swashplates and that the swashplate stop is not available for the AMCS system. Also the FORTRAN name of some of the control inputs change.

The user is cautioned on numerical problems. In the case of the hard swashplate with stiff springs, the swashplate frequencies may be driven so high that numerical instabilities may occur. The locked swashplate may be preferred especially if the user is including only the three lowest blade modes and is not interested in pitch horn or torsion dynamics.

The user should be acquainted with Volume I, especially Sections 5.5.6, 5.5.8 and 6.10. Note the two axis systems: the swashplate axis and the swashplate control axis. The swashplate axes are aligned with the principal (equal hub) axis with the X roll axis forward, the Y pitch axis rightward and the Z heave axis downward. The control axis lags the swashplate axis by an azimuth CHI or CHIG. Lag, the negative of lead, is taken positive in a direction opposite to rotor rotation where the advancing blade is on the right. With IAMCS = 0 the control loads will come from the pilot stick through the stick actuators, see Section 3.3.4.1, and act through the control springs with rates QKXCS and QKYCS. In the AMCS system the pilot actuators torques the control gyro which in turn loads the

TABLE 3-42. SWASHPLATE INPUTS

Input Quantity			Address
Swashplate to Feathering Geometry			
ψ_{PH}	BETAG	Pitch horn lead azimuth	125
e	E	Pitch horn arm	136
$(d/e)_0$	DOEO	Ratio of cyclic feathering to swashplate angle at zero collective	271
$(d/e)_1$	DOE1	Variation of $(d/e)_0$ with collective	272
Control Input (RA(490)) = IAMCS = 0			
ψ_C	CHI	Azimuth swashplate leads control axis	119
K_{XCS}	QKXCS	Swashplate roll control spring rate, control axis	123
K_{YCS}	QKYCS	Swashplate pitch control spring rate, control axis	124
Control input (RA(490)) = IAMCS = 1			
ψ_C	CHIG	Azimuth swashplate axis leads control axis	344
$K_{\phi C}$	KPHCON	Swashplate roll control spring rate, control axis	376 (1)
$K_{\theta C}$	KTHCON	Swashplate pitch control spring rate, control axis	377 (1)

(1) Enter 1.0 if IAMCS = 0 to prevent zero divide.

TABLE 3-42. SWASHPLATE INPUTS (Continued)

Input Quantity			Address
Springs, Dampers, Friction and Slop			
$K_{\phi SP}$	KPHCON	Swashplate roll spring rate in control axis	376
$K\theta_{SP}$	KTHCON	Swashplate pitch spring rate in control axis	377
$C_{\phi SP}$	CPHCON	Swashplate roll damper rate in control axis	378
$C\theta_{SP}$	CTHCON	Swashplate pitch damper rate in control axis	379
$\delta_{S,SP}$	GASTOP	Swashplate stop contact angle	1276 (2)
$K_{S,SP}$	GKSTOP	Swashplate stop spring rate	1277 (2)
$\delta_{\phi SP}$	PSLOPL	Swashplate roll slop limit in swashplate axis	2551 (3)
$\delta_{\theta SP}$	TSLOPL	Swashplate pitch slop limit in swashplate axis	2552 (3)
$\dot{\phi}_{SP,BK}$, $\dot{\theta}_{SP,BK}$	RLG	Swashplate friction break point	116
$M_{FR,\phi SP}$, $M_{FR,\theta SP}$	FCG	Swashplate friction at break point	117
Vertical Motions			
$K_{1Z_{SP}}$	QKGZ1	Swashplate vertical spring rate at low deflections	137
Z_{1SP}	ZG1	Swashplate vertical spring breakpoint	141
$K_{2Z_{SP}}$	QKG2Z2	Swashplate vertical spring rate at high deflection	140

TABLE 3-42. SWASHPLATE INPUTS (Continued)			
Input Quantity			Address
Vertical Motions (continued)			
F_C	FIDDLE	Swashplate vertical spring centering force	1494
C_{ZSP}	QCGZ	Swashplate vertical damping rate	138
$R_{Z\emptyset}$, $R_{Z\theta}$	DGDHG	Swashplate rotary to vertical damping coupling	1263

2 Available only for normal swashplate configuration when IAMCS = 0

3 Available only for AMCS if made operative by setting IAMCS = 1

swashplate through control springs with rates KPHCON and KTHCON. The pilot collective is modeled the same for both systems, again see Section 3.3.4.1.

BETAG and E describe the pitch horn cant angle and arm length, see Figure 3-12.

If the pitch horn is behind the blade, instead of leading like the figure, E is negative and BETAG is π radians minus the physical angle.

Springs, and if installed the dampers, are modeled with rates KPHCON, ..., CTHCON. These are established in gyro control axis. Therefore, terms which would couple pitching loads to roll deflections and vice-versa do not exist. Note the gyro springs are defined with the controls blocked, and the control springs with the gyro blocked.

Gyro stop springs are modeled. They are circular in the sense that the stop spring rate is the same in any direction. Friction is also the same in any direction. It follows the function illustrated in Volume I, Figure 6-3. Pure viscous friction is obtained by making RLG very large and the ratio FCG/RLG equal to the viscous friction coefficient in ft-lb/rad. A moderate value of RLG sets a rate beyond which the friction is limited to the stiction value FCG. A tiny RLG value (not zero) obtains pure stiction for all practical purposes.

Swashplate slop differs in the roll and pitch axis. The gyro axis is the reference axis for slop. Use a value equal to half the total slop band.

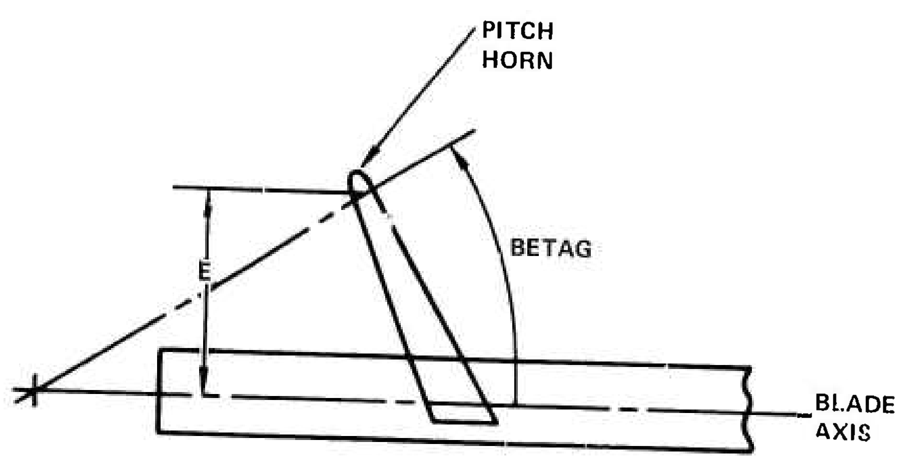


Figure 3-12. Pitch Horn Geometry

Most of the swashplate collective inputs are self-explanatory. FIDDLE supplies a means for "centering" the low spring rate portion of the swashplate travel. DGDHG is a cyclic to collective damper coupling factor. The swashplate cyclic dampers produce a collective force proportional to the swashplate deflection and the cyclic damper load. See Volume I, Section 6.10.4 for equations.

When the user operates the program with the swashplate locked by setting HARDSP = 1, only a kinematic relation will exist between the pilot stick and the main rotor cyclic angles. The HARDSP nomenclature can be confusing since a hard swashplate might not be modeled as a locked swashplate. Only six inputs as listed in Table 3-43 need be considered. If the actual swashplate deflections are immaterial, the user may find nominal values of DOF = 1, DOE1 = 0 and BETAG = 0 convenient. Then if CHI = 0 an aft stick will gear the swashplate to roll right through the gear ratio. In turn the swashplate deflection will cause an equal amount of pure longitudinal cyclic to appear. The overall equation is

$$\begin{Bmatrix} A_{1S} \\ B_{1S} \end{Bmatrix} = \left(\left(\frac{d}{e}\right)_0 + \left(\frac{d}{e}\right)_1 \theta_0 \right) \begin{bmatrix} \sin\psi_{PH} & \cos\psi_{PH} \\ \cos\psi_{PH} & -\sin\psi_{PH} \end{bmatrix} \begin{bmatrix} \cos\psi_C & -\sin\psi_C \\ \sin\psi_C & \cos\psi_C \end{bmatrix} \begin{Bmatrix} -K_{XC} X_C \\ K_{YC} Y_C \end{Bmatrix} \tag{3-51}$$

which can be derived from Volume I, Sections 5.5.8, 6.10.4 and 6.10.5 where K_{XC} and K_{YC} are interpreted as gear ratios rather than spring rates.

3.3.15 Direct-Flap Feedback Control Gyro

The user is assumed to have read the section on the swashplate inputs which will supply needed background. The control gyro operates when RA(490) = IAMCS = 1. The desired inputs are listed in Table 3-44. The description of the control gyro is found in Volume I, Sections 5.5.7 and 6.11. The math symbols in the tables are the same as used in those sections.

As discussed in Volume I, the control gyro degrees of freedom, which are roll and pitch, are considered secondary and decoupled from the primary degrees of freedom. Therefore, mass inputs are described herein instead of the weight and balance section which only refers to masses related to the primary degrees of freedom. The gyro gimbals are assumed symmetric and only IZZGNR is input. An unbalance mass can be added to the gimbals in the stationary system. This mass could, for instance, provide an input proportional to load factor.

TABLE 3-43. CONTROL INPUT FOR LOCKED SWASHPLATE (RA(42) = HARDSP = 1)			
Input Quantity			Address
K_{XC}	QKXCS	Ratio swashplate control roll to longitudinal stick deflect	123
K_{YC}	QKYCS	Ratio swashplate control pitch to lateral stick deflection	124
ψ_C	CHI	Azimuth swashplate axis leads control axis	119
$(d/e)_0$	DOEO	Ratio cyclic feathering to swashplate angle at zero collective	271
$(d/e)_1$	DOE1	Variation of $(d/e)_0$ with collective	272
ψ_{PH}	BETAG	Pitch horn lead azimuth	125

The pilot control input programming mimics the swashplate control programming. The gyro controls the swashplate and the no-load gear ratios GRK and GRD are required. A first order gyro to swashplate actuator is modeled with time constant TAUACT.

In contrast to the swashplate, the gyro springs and dampers are modeled in the gyro axis, not the gyro control axis. Hence,cross-coupling constants are available for input. Simple gyro stiction (no viscous friction) is allowed, input KFPHG.

The most complex series of inputs relate to the feedback from blade flap to the gyro. Volume I, Section 6.11.4 is recommended reading. A feedback lever is mounted on top of the fixed hub arm, one lever for each blade, at an azimuth PSIFBL ahead of the blade axis. The modal description of the blade modes at the mount station is given in Section 3.3.7.2. The geometry of the lever is described by its length XSTDIF, and the azimuth PSIFBL and radius RFBL coordinates of the inboard, free end of the lever. Stiction is inputted in terms of a displacement ZJLIM of the inboard end of the lever which equal the total stiction moment divided by the feedback spring rate KFBC. The total moment means the difference between the plus and minus value of stiction. The other end of the feedback mechanism attaches to the gyro with a leading azimuth PSIFB, again relative to the blade axis. The magnitude of the feedback is determined by the difference

TABLE 3-44. CONTROL GYRO INPUTS

Input Quantity			Address
Weight and Balance			
I_{ZZ_G}	IZZGR	Gyro rotor polar inertia	350
$I_{ZZ_{G,NR}}$	IZZGNR	Gyro non rotating inertia	360
m_{GUB}	MUB	Gyro unbalance mass	347
X_{UB}	PXPZ	Unbalance mass offset in gyro X axis	348
Y_{UB}	PYPZ	Unbalance mass offset in gyro Y axis	349
Pilot Control			
K_{XC}	QKXCSG	Longitudinal stick spring rate	342
K_{YC}	QKYCSG	Lateral stick spring rate	343
$\psi_{C,G}$	CHIG	Azimuth gyro axis leads stick control axis	345
Flap feedback			
$X_{RM}-X_J$	XSTDIF	Length of feedback lever	2514
$\Delta Z_{J,LIMIT}$	ZJLIM	Gyro feedback displacement deadband total travel	2546
Ψ_{FB}	PSIFB	Azimuth gyro feedback attach. point leads the blade axis	2516
X_{FBn}	RFBL	Radius of inboard end of feedback lever	396
X_{FBG}	RFB	Radius of feedback attach. point to gyro	2547

TABLE 3-44. CONTROL GYRO INPUTS (Continued)

Input Quantity			Address
Flap Feedback (continued)			
ψ_{FBn}	PSIFBL	Azimuth inboard end of feedback lever leads blade	397
ℓ_{FB}	LFB	Feedback spring preload displacement	2492
K_{FB}	KFBG	Gyro feedback spring rate	2545
Gyro to Swashplate Control Axis			
$G_{\phi GSP}$	GRK	Ration gyro roll per unit swashplate control roll	362
$G_{\theta GSP}$	GRD	Ratio gyro pitch per unit swashplate control pitch	363
τ_{GSP}	TAUACT	Gyro to swashplate actuator time constant	351
Springs, Dampers, and Friction			
$K_{\phi\phi SP}$	GSKL	Gyro spring rate in roll	352
$K_{\theta\theta_{SP}}$	GSDM	Gyro spring rate in pitch	356
$K_{\phi\theta_{SP}}$	GSDL	Gyro coupling spring rate for roll moment due to pitch angle	353
$K_{\theta\phi SP}$	GSKM	Gyro coupling spring rate for pitch moment due to roll angle	355
$C_{\phi\phi SP}$	GFKDL	Same function as gyro spring inputs but for gyro damper rates	
$C_{\theta\theta_{SP}}$	GFDDM		358
$C_{\phi\theta_{SP}}$	GFDDL		354
$C_{\theta\phi SP}$	GFKDM		357
M_{GFR}	KFPHG	Gyro stiction	395

in vertical position of the inboard end of the feedback lever and the gyro feedback attachment point times the feedback spring. The description is now complete except for a minor input LFB, a preload deflection approximately equal to the depth of the control gyro below the hub.

3.3.16 Shaft Bending

Main rotor shaft bending degrees of freedom can be added to the equation set by setting IFLEX = 1. When this is done, some additional inputs are required per Table 3-45. These are explained below. The partials XTHTF and YPHIF give feet of fuselage axis motion per radian of shaft tilt. Figure 5-3, Volume I, illustrates the motions occurring for a positive shaft pitch bending. Note the longitudinal partial has a negative value. The lateral partial is normally positive. The spring rate, FKS, is foot-pounds of fuselage moment for a radian of shaft tilt, the same for both axes. The damping rate, however, can be different with DPHIS and DTHTS for the roll and pitch axis, respectively. The damping level would normally be small and due to structural damping only.

Swashplate tilt may occur with shaft bending. CAPHIS can be thought of as a shaft bending delta 3 effect. Imagine the fuselage to be fixed and shaft bending causing the hub to rotate nose up one radian. Then the amount of swashplate tilt would be CAPHIS for the no load condition, positive if both tilts are in the same direction. When shaft bending is active, a trim time constant is required for trimming the shaft angles. The time constant is supplied as TC(4). The input quantities are reviewed in Table 3-45.

If the direct-flap feedback control system is being used and the flexible shaft option is not active, a shaft bending delta 3 effect can be obtained by inputting FKSPT (RA 273). The program will adjust the swashplate moments according to the product of FKSFT, appropriate hub moment and spring rate.

3.3.17 Induced Flow

The steady-state induced flow pattern is determined internally by the program. The only input for main rotor downwash is a time constant, TC(1) in TRIM and TC(2) in FLY. The downwash time constants were discussed in the section on TRIM initialization. The downwash velocities are determined by first-order lag equations which require time constants.

The effect of main rotor downwash on the fuselage-wing combination and on the horizontal tail is presented to the program in the form of interference factors. These interference factors are tabular functions of wake angle.

TABLE 3-45. SHAFT BENDING DATA		
Input Quantity		Address
IFLEX	Shaft bending option flag 1=on	399
XTHTF	$\partial X_F/\partial \theta_S$	364
YPHIF	$\partial Y_F/\partial \phi_S$	365
FKS	Shaft bending spring	375
CAPHIS	Shaft to swashplate coupling	398
DPHIS	Shaft roll tilt damping	2549
DTHTS	Shaft pitch tilt damping	2550
TC(4)	Shaft bending trim time constant	290

The wake angle is zero in hover, 90 deg at extreme forward flight speeds, and -90 deg at extreme rearward speeds. The table should have all values from +180 to -180 deg. Values less than -90 deg or greater than 90 deg mean the induced airflow is upward through the rotor disk due to an unusually high rate of descent or negative rotor lift in severe maneuvers.

The tables are identified with a doubly dimensioned array with the main rotor to wing function beginning at FXTN(1,1) and the main rotor to horizontal tail function beginning at FXTN(1,2). The functions will be linearly interpolated. The format is demonstrated in Table 3-46.

The tail rotor acts on the vertical tail. The net load is expressed by STR which is a factor by which the unblocked tail rotor thrust is multiplied to give the blocked value.

A fixed wing is allowed. DEODA specified $\partial \varepsilon_{HT}/\partial \alpha_F$, the radians of downwash at the tail due to the fixed wing per radian of freestream angle of attack.

All the above refer to the vertical component of the downwash due to lift on the main rotor and on the fixed wing. A velocity decrement on the tail surfaces and the tail rotor is allowed due to fuselage and main rotor drag. ETAE is a factor less than one by which the freestream forward velocity is multiplied to give the average wake velocity at the tail. Inputs, including FXTN, are summarized in Table 3-47.

TABLE 3-46. WAKE ANGLE FUNCTION

Main rotor to wing function
FXTN(1,1) = N, (number of point pairs)
FXTN(2,1) = χ_u, 1
FXTN(3,1) = F_χ, 1
FXTN(4,1) = χ_u, 2
FXTN(5,1) = F_χ, 2
.
.
.
FXTN(2N, 1) = χ_u, N
FXTN (2N + 1,1) = F_χ, N
(Maximum number of data pairs is 12)
Main rotor to horizontal tail function
FXTN(1,2) = (number of point pairs)
.
.
.

TABLE 3-47. INDUCED FLOW INPUTS

Input Quantity		Address
FXTN(1,1)	Main rotor to fuselage-wing interference factor table	1751-1775
FXTN(1,2)	Main rotor to horizontal tail interference factor table	1776-1800
STR	Tail fin blockage factor	97
DEODA	$\partial\varepsilon/\partial\alpha$ at tail	135
ETAE	Equivalent velocity ratio at the tail	106

4. PLANNING AND OPERATING THE PROGRAM

4.1 RUN TIME REQUIRED

REXOR is a complex program and run time costs are considerable. The pressures to get a job done often precludes proper attention to computer time savings. Nonetheless, a portion of the user's time should be made available for carefully checking the runs already completed, checking the inputs for the runs to be made and in planning the scope of the project to begin with.

Direct control over run time is obtained with RA(36) = TCUT which limits the number of rotor revolutions in TRIM and RA(1498) = TSTOP which limits the time in FLY. Cases should be rare where TCUT exceeds 24 cycles and TSTOP exceeds 8 seconds. These values should be examined for every new series of cases to see if they can be reduced.

The program usually meets the trim criteria before the number of rotor revolutions reaches TCUT. The run should not be rejected out of hand for trim failures as the trim criteria for the controls are fairly severe. RA(48) = IPLOT should be 3 or 4 so time histories of the control motions in TRIM can be examined. Their traces have a typically exponential character and the user can readily see about how close to trim the case is. A 0.1 degree error in cyclic main rotor angles, say, is certainly not cause for rejection for a lot of cases.

Direct control is also available on the number of time points computed per rotor revolution, RA(32) = AZT in TRIM and RA(51) = NAZ in FLY. AZT is typically equal or less than NAZ. The values are dependent on whether high-frequency modes are operative or not. The following flags relate to high-frequency modes: RA(399) = IFLEX, RA(42) = HARDSP, RA(2870) = IDYN, RA(1480) = IPHORN and RA(2515) = IFLAP2. To a lesser extent the values depend on the quasi-static pitch horn and torsion, flags RA(1487) = KPH and RA(1497) = TORFLG. Serious consideration should be given to operating the program with as few degrees of freedom as is reasonable.

REXOR has been run for minimal degrees of freedom with NAZ as low as 24. Normally, though, NAZ is more like 120, 180 or 240, and sometimes even 360 to provide numerical stability. In computing the AH-56A Cheyenne inplane stability, damping resolution of the order of 1/10 of the structural damping was experienced providing the azimuth interval was small enough to preclude numerical instability.

Summarizing, run times can be computed based on REXOR input values. The run time per case, where a case is defined in Section 3.1 is computed

$$t_c = (t_{TRIM} + t_{FLY})/60, \text{ units of minutes/case}$$

where

$$t_{TRIM} = (k)(AZT)(TCUT)$$

$$t_{FLY} = (k)(NAZ)(\Omega)(TSTOP)/2\pi$$

and

$$\Omega = RA(52)$$

The other addresses are defined above. The parameter (k) has units of sec/azimuth, and can be determined by measuring a computer run. The data in Table 4-1 is offered as a reference.

TABLE 4-1. MACHINE TIME ESTIMATES

Machine	k	
	No dynamic stall	With dynamic stall
IBM 360/91	0.16	0.18
CDC 6600	0.48	0.54
IBM 360/65	1.12	1.26

The 360/91 values are accurate. Values for the other machines are estimates. It should be noted that the above values are based on a four-bladed rotor system. Costs for teetering configurations (two blades) would be approximately two-thirds as much.

The user is advised to proceed slowly in submitting cases. Look over the output of the last case carefully. The harmonic analysis tabulation obtained with the RA(1257) = IHAFLG may be helpful. The idea is to double check the inputs, to spot and remove errors. Having a series of runs "bomb" just because one little input was wrong or missing is expensive.

4.2 TRIM SAVING PROCEDURES

Trim save cards can be obtained by actuating the RA(47) = IPUNCH flag and this is highly recommended even if the next case varies considerable from the flight conditions of the trim save case. Some of the trim save inputs can be filled out by hand and will aid trim. Of first importance are the downwash of the main rotor and the tail rotor, RA(65) = WIMR and RA(77) = WITR. Other quantities which may be initialized to aid in reaching final trim values are RA(53), RA(54), RA(55), RA(56), RA(57), RA(58), RA(59) and RA(63) if they are among the set of trim variables selected by the trim option, RA(142). There are other factors discussed in detail in Section 3.3.3.

4.3 TROUBLESHOOTING

Troubleshooting here shall be limited in discussion to the effort required to fly a new helicopter configuration in the program where only relatively simple program changes are required. The effort required to check out a major change of the program that affects the primary degrees of freedom is at least an order of magnitude greater than that required to check out new input data.

Checkout of the program should proceed by repeating a known case and is aided by correlating with any test data that is available, such as whirl tower or tie-down tests. Lacking test data, simpler analyses can sometimes be used in limited comparisons of performance and handling qualities. In areas where test data or simpler analyses are not available, the user must use great care in evaluating the inputs and in determining the "reasonableness" of the output results. All the output should be carefully examined and new output programmed if doubts can not be clarified. Sometimes special check can be devised such as fixing a roll rate on the rotor and observing the value of the required pitch processional moment, or observing the flap displacement and root blade moment obtained with an increment in the feather angle, etc.

The steps required to get a new configuration up and running can be serialized as follows:

1. Gathering of data. The user must obtain all details on the configuration especially in regard to blade sweep, blade droop, blade jogs, feather bearing cone angles, pitch horn stiffness, blade inertial and modal data, pitch-flap-lag couplings,

swashplate stiffness and shaft flexibility. The stability of the rotor modes are often highly dependent on the values of these inputs.

2. Write up and implement program modifications. Here only simple modifications are assumed which are almost inescapeable for a new configuration. One needs to be more careful with changes that affect the physical model being represented through the equations of motion compared to changes in say, the output-input format.

3. Decide what degrees of freedom can be removed. The characteristic frequency of the torsion or the swashplate may be too high to be significant. The engine degree of freedom usually can be turned off except for autorotation or extreme maneuvers. A fixed shaft study involving the blades and the swashplate degrees of freedom only may be appropriate. Another strategy that can be employed is to turn all possible degrees of freedom off to begin with to simplify the checkout, then add shaft bending, etc., and recheck the output.

4. Compute one pass of the program. Here the simple errors which lead to zero divide, no initialization, etc., will be apparent. This stage is complete when the tabulation for the first time point appears. The tabulation of the inputs include a card listing and then a relisting of input in like groupings. The inputs are rechecked using the like-grouping format which may make it easier to spot wrong numbers. Also at this time the statements for program changes are reviewed for correctness.

5. The next stage occurs when a portion of the TRIM time history is obtained. Check all quantities in the tabulation of the first time point against the inputs for reasonableness; also check for signs, zeros and the absence of huge numbers. Examine the time histories to see that all quantities have started off properly. If a rapid divergence or oscillation has occurred, numerical instabilities are to be suspected; a low rate could mean the trim gains are too low. A good value is one that causes a pure, rapid convergence without overshoot oscillations or indications the trim variable is following vibratory loads. Numerical instabilities may be cured by using a smaller increment between time points. A rapid divergence may, however, be a simple input error in the spring rate, etc.

6. Next, a portion of the FLY time history will run. Check the TRIM time histories to see the trim variables plots are almost horizontal near the end of TRIM indicating a true TRIM condition has been closely approached. In FLY numerical difficulties may again occur. Check the tabulation at the end of TRIM and the beginning of FLY for reasonableness of values. A point is

finally reached when the FLY plots appear reasonable, that the system is stable without any control input (or if not, should be expected) and that the system moves in the proper direction and with about the expected magnitude upon application of a control input. A good rule is to apply no input for the first half or full second of FLY. This procedure helps determine the quality of TRIM and provides a reference level for the control input to follow. Difficulties can be evident which may only be due to an unsatisfactory design. Careful attention would be paid to the inplane mode stability in its collective, cyclic or reactionless manifestations. Parameter sensitivity studies may be in order or perhaps more flight conditions should be investigated.

A few messages are printed, some relating to "bomb" flags. These flags are not intended to be an error detection system. Also the location from within the program where they originate is not indicated.

There are a few large number detectors which stop the case when they are exceeded. Included are excessive values for the trim variables, for root blade loads and blade deflections. The intention is to detect a divergence from within the program before a computer overflow occurs. Then, the time history plots with automatic scaling based on the largest values will be useful. Without "bomb" tests a computer overflow number like 10^{77} will cause all plot data to look like zero except for the last point.

5. TABULATED OUTPUT

An example of tabulated data is provided by the reduced copy of a computer printout, Table 5-1. The major sub-blocks of data are titled and underlined in the tabulation. The harmonic analysis tabulation is included. The only tabulation available which does not format like one or more of the pages of the figure is when RA(46) = ICONTR is on and a special printout of the mass matrix and related data is obtained. This data is for debugging program modifications.

The first portion of the tabulation prints input data; for details see section 3. The next portion prints values for the same set of variables at the beginning and end of TRIM. In addition, an extra tabulation is printed at the end of the extra revolution added to TRIM for harmonic analysis. The last two tabulations should be checked to see how close corresponding values are in order to evaluate the resolution of TRIM and hence the numerical quality of the harmonic analysis.

Section 3.3.6 should be consulted when interpreting harmonic analysis although the titles are descriptive. The user should be aware that the blade loads are being computed with a greater numerical precision than normal at the expense of calling the blade subroutine (SWEEP) twice at each time point. In normal operation the blade subroutine is entered with the old accelerations plus the new velocities and displacements found by integrating to the next time point. The blade loads plus loads from the fuselage, tail rotor, etc., are used to find the new accelerations. Now at this point, for harmonic analysis only, and before recycling the program and integrating to the next time point, the blade subroutine is entered again. The blade loads are then computed using the accelerations, velocities and displacements all at the same time point. A significant improvement in blade loads results although the azimuth step may be only 2 or 3 degrees. The acceleration is sensitive in value to high frequencies and a phase error of a few degrees at one per revolution (1P) is many times that at the frequency of the highest mode.

The tabulation finishes with printouts at the beginning and end of FLY similar to those in TRIM.

TABLE 5-1. SAMPLE REXOR TAB OUTPUT

```
INPUT  DATA                                               INPUT CARD LISTING
CARD  COLUMNS  12345678901234567890123456789012345678901234567890123456789012345678901234567890

                  (RA ADDRESS)                                                         (CARD SEQUENCE NUMBER)
               8888         MASTER  DATA  DECK    BELL  AH-1G     11-20-75  (DATA TITLE)       00000010
                 31    32   1000.          180.                                                00000020
                 36         24.                                                                00000030
                 42         1.                                                                 00000040
                 45    46   1.             1.                                                  00000050
                 48         3.                                                                 00000060
                 51         180.                                                               00000080
                346         -.375                                                              00000090
                 57         .26                                                                00000110
                 62         123.                                                               00000120
                 65         5.0                                                                00000130
                 78         1.                                                                 00000140
                 80    81   .01            22.                                                 00000150
                 91         217.45                                                             00000160
                 93         1000.                                                              00000170
                 95    96   8.22           .65         26.725                                  00000180
                101   103   16.54          25.08       2.5                                     00000190
                106         .9                                                                 00000200
                109   110   .00205         2.25                                                00000210
                123   124   .178           .237                                                00000220
                135   136   .45            -.75                                                00000230
                143   144   1.             -1.                                                 00000240
                146         -.5                                                                00000250
                150         4.                                                                 00000260
                151   154   0.             2.          2.01        8.                          00000270
                171   174   0.             0.          .042        .042                        00000280
                271         1.                                                                 00000290
                274         -1.2375                                                            00000300
                287   289   1.             .05         .1                                      00000310
                292   293   .025           .025                                                00000320
                298         1.                                                                 00000330
                364   365   -6.            6.                                                  00000340
                374   377   -1.16              9.168E05 1.0        1.                          00000350
                399         1.                                                                 00000360
                437   438   1.5            1.                                                  00000370
                494         1000.                                                              00000380
               12501252     .00057         .00057      .0156                                   00000390
               1257         1.                                                                 00000400
               1266         2.75                                                               00000410
               1270         2.75                                                               00000420
               12791280     5.             .035                                                00000430
               1291         1098.                                                              00000440
               1348         5.356                                                              00000450
               14611464     1559.          11174.      8759.       400.        580.            00000460
               14711472     20.            2.8                                                 00000470
               14731475     1.             20.4        5.12                                    00000480
               14761477     0.             .75                                                 00000490
               19811985     -.0016         .03         -.0016      .01         -.03            00000500
               1986         -.075                                                              00000510
               2559         .5                                                                 00000520
               26812685     27.8           2.67        5.96        4.25        5.73            00000530
               2686         .94                                                                00000540
               2688         5.                                                                 00000550
               2692         1.                                                                 00000560
               26962697     .12            .12                                                 00000570
```

TABLE 5-1 - Continued

```
INPUT DATA
CARD COLUMNS 1234567890123456789012345678901234567890123456789012345678901234567890

     454      -.1783                                                              00000580
     467      -.0698                                                              00000590
     469      -1.154                                                              00000600
     472      -.08846                                                             00000610
     476      2.2185                                                              00000620
 26012605     -180.        -16.         -14.         -12.         -10.            00000630
 26062610     -8.          -6.          -4.          -2.          0.              00000640
 26112615     2.           4.           6.           8.           10.             00000650
 26162620     12.          14.          16.          18.          180.            00000660
 26212625     0.           -.304        -.285        -.265        -.246           00000670
 26262630     -.226        -.206        -.186        -.167        -.147           00000680
 26312635     -.128        -.108        -.089        -.069        -.049           00000690
 26362640     -.028        -.011        .009         .029         0.              00000700
 26512665     .5           .353         .320         .292         .267            00000710
 26652670     .246         .228         .214         .204         .197            00000720
 26712675     .194         .194         .196         .206         .217            00000730
 26762680     .232         .250         .272         .298         .5              00000740
     142      4.0
     297      16.5
     299 300  30.          50.
     301      1.0
     302 306   2.00000E 00 3.00000E 00 4.00000E 00 1.00000E 01 1.10000E 01              46
     307 311   1.20000E 01 5.00000E 00 8.00000E 00 9.00000E 00 6.00000E 00              47
     312 316   7.90000E 01 5.30000E 01 5.50000E 01 5.60000E 01 8.00000E 01              48
     317 321  13.          90.          81.          47.          7.
     322 326  85.          86.          87.          88.          89.
     327 330  14.          15.          51.          52.
 17511755      1.80000E 01-1.80000E 02 6.23000E-01 0.0         6.23000E-01             169
 17561760      4.00000E 01 7.40000E-01 7.00000E 01 8.80000E-01 8.00000E 01             170
 17611765      6.60000E-01 9.00000E 01 8.40000E-01 1.00000E 02 5.60000E-01             171
 17661770      1.10000E 02 3.83000E-01 1.80000E 02 3.83000E-01 0.0                     172
 17761780      2.20000E 01-1.80000E 02 0.0         2.00000E 01 0.0                     173
 17811785      5.00000E 01 2.00000E 00 6.00000E 01 1.92000E 00 7.40000E 01             174
 17861790      1.52000E 00 8.00000E 01 1.34000E 00 9.00000E 01 1.14000E 00             175
 17911795      1.00000E 02 1.08000E 00 1.10000E 02 1.04000E 00 1.20000E 02             176
 17961800      9.60000E-01 1.80000E 02 0.0         0.0         0.0                     177
 18011805      3.00000E 00 7.00000E 00 2.10000E 01 1.40000E 01 5.40000E 01             178
 18061810      4.00000E 00 1.60000E 01 1.50000E 01 1.80000E 01 1.90000E 01             179
 18111815      1.70000E 01 1.30000E 01 2.90000E 01 2.80000E 01 2.70000E 01             180
 18161820      2.60000E 01 3.00000E 01 2.50000E 01 2.40000E 01 2.30000E 01             181
 18211825      3.60000E 01 1.0         2.0         4.00000E 01 4.20000E 01             182
 18261830      5.20000E 01 5.10000E 01 4.70000E 01 7.10000E 01 6.90000E 01             183
 18311835      7.00000E 01 6.60000E 01 3.10000E 01 3.20000E 01 3.90000E 01             184
 18361840      4.50000E 01 4.40000E 01 5.00000E 01 4.90000E 01 5.60000E 01             186
 18411845      5.50000E 01 5.30000E 01 4.10000E 01 58.0        57.0                    187
     300      45.0
              END OF MASTER DATA DECK                                             00000750
    7777                THIS IS A BLADE DATA SET
       1      10-31-75 BELL  AH-1G BLADE DATA REXOR SIMULATION MODEL GAIDELIS
      16      CASE =  201 THETAO= 15.0 OMEGA= 33.93  CONV. 2ND FLAP MODE
     498 500    0.1300E 02  0.1000E 01  0.2000E 01
      52        0.3393E 02
      56        0.2618E 00
    1269        0.1500E 02
      82  84    0.4916E 02  0.3522E 02  0.3393E 02
```

TABLE 5-1 - Continued

```
INPUT DATA
CARD COLUMNS 12345678901234567890123456789012345678901234567890123456789012345678901234567890

 501 505    0.1000E 01  0.2250E 01  0.4250E 01  0.6000E 01  0.7500E 01
 506 510    0.9500E 01  0.1075E 02  0.1250E 02  0.1475E 02  0.1700E 02
 511 513    0.1900E 02  0.2025E 02  0.2200E 02
 541 545    0.2306E 01  0.1676E 01  0.1122E 01  0.3360E 00  0.2132E 00
 546 550    0.2634E 00  0.2086E 00  0.2988E 00  0.3793E 00  0.2150E 00
 551 553    0.1879E 00  0.4950E 00  0.9483E 00
 761 765    0.0         0.1500E-01  0.5995E-01  0.1178E 00  0.1787E 00
 766 770    0.2720E 00  0.3354E 00  0.4296E 00  0.5576E 00  0.6916E 00
 771 773    0.8140E 00  0.8914E 00  0.1000E 01
 921 925    0.0         0.3198E-03  0.1818E-02  0.4222E-02  0.7048E-02
 926 930    0.1153E-01  0.1456E-01  0.1900E-01  0.2493E-01  0.3105E-01
 931 933    0.3659E-01  0.4007E-01  0.4495E-01
 801 805    0.0        -0.6531E-01 -0.1236E 00 -0.1463E 00 -0.1442E 00
 806 810   -0.1229E 00 -0.1055E 00 -0.7897E-01 -0.4386E-01 -0.8914E-02
 811 813    0.2117E-01  0.3922E-01  0.6403E-01
 961 965    0.0         0.7052E-01  0.1536E 00  0.2302E 00  0.2989E 00
 966 970    0.3932E 00  0.4529E 00  0.5372E 00  0.6462E 00  0.7558E 00
 971 973    0.8534E 00  0.9145E 00  0.1000E 01
 841 845    0.0         0.1413E-01  0.2796E-01  0.3687E-01  0.4324E-01
 846 850    0.4910E-01  0.5193E-01  0.5515E-01  0.5829E-01  0.6051E-01
 851 853    0.6167E-01  0.6198E-01  0.6208E-01
10011005    0.0         0.4426E-03  0.1002E-02  0.1621E-02  0.2039E-02
10061010    0.2348E-02  0.2466E-02  0.2582E-02  0.2681E-02  0.2748E-02
10111013    0.2780E-02  0.2789E-02  0.2792E-02
 881 885    0.0        -0.3386E-01 -0.2387E-01 -0.6298E-02  0.5329E-02
 886 990    0.1246E-01  0.1426E-01  0.1514E-01  0.1538E-01  0.1508E-01
 891 893    0.1449E-01  0.1424E-01  0.1415E-01
10411045    0.0         0.4079E-01  0.4233E-01  0.4470E-01  0.4636E-01
10461050    0.4752E-01  0.4793E-01  0.4828E-01  0.4857E-01  0.4876E-01
10511053    0.4885E-01  0.4887E-01  0.4688E-01
13011305    0.1841E 00  0.7895E-01  0.1572E 00  0.1269E 00  0.9224E-01
13061310    0.1176E 00  0.9498E-01  0.9296E-01  0.8246E-01  0.6992E-01
13111313    0.6680E-01  0.7288E-01  0.1044E 00
 601 605   -0.1168E-01 -0.2234E 00 -0.1460E 00 -0.1035E 00 -0.1370E 00
 606 610   -0.1214E 00 -0.9380E-01  0.7268E-02  0.9929E-01 -0.2587E-02
 611 613    0.4461E-02  0.1857E 00  0.2042E 00
  85       -0.1745E 00
 128        0.1117E 01
 129        0.1267E 01
 275 278    0.3712E-02 -0.2065E-01  0.1695E-01 -0.6983E-01
 279 282    0.8399E-04  0.2518E-01  0.3800E-03  0.7596E-01
12411245    0.4582E 04 -0.3925E 01 0.0        -0.3925E 01  0.1660E 03
11211125    0.0         0.1023E 00  0.1932E 00  0.2727E 00  0.3409E 00
11261130    0.4318E 00  0.4886E 00  0.5682E 00  0.6705E 00  0.7727E 00
11311133    0.8636E 00  0.9205E 00  0.1000E 01
12011205    0.0         0.4545E-01  0.4545E-01  0.4545E-01  0.4544E-01
12061210    0.4545E-01  0.4545E-01  0.4545E-01  0.4545E-01  0.4545E-01
12111213    0.4545E-01  0.4545E-01  0.4545E-01
1201       .0455                                                      00000100
 283 286   0.0         .05076      0.0          .1083
  50       2001.                                                      00000070
 663       1.0
1498       3.0
 351       1.0
 290       .01
```

TABLE 5-1 - Continued

```
INPUT DATA
CARD COLUMNS 1234567890123456789012345678901234567890123456789012345678901234567890

      299       32.0
      331  332  16.0        17.0
       32       120.0
       80       .02
      287       .3
      346       .375
     19811985   -.0008      .015        -.0008      .001        -.008
     1986       -.0375
       50       2002.
       96       7.85
     19841985   .004        -.015
     1498       2.0
       5?       2005.
      364  365  -1.6        1.6
      366       8.9
     25492550   3283.       3283.
     19841985   .003        -.02
       50       2007.
     1981       -.002
     198?       -.025
       50       2008.
       46       0.0
       50       2009.
       50       2010.
       50       2011.
       53   57   0.0        -2.01143E-02 3.43701E-02 2.20736E-01 8.12860E-02
       58   59  -1.19038E-02-2.26512E-02
       62   66   1.23000E 02 0.0         0.0         1.05046E 01 5.81150E-03
       67   70  -1.52924E-03 0.0         0.0         0.0
       77   78   3.27100E-02 1.23087E 01
      661  662   0.0         0.0
     12521252    5.70000E-04
     16611665   -9.12822E-02 2.79012E-01 7.28184E-02 0.0         0.0
     16661670    0.0         0.0         0.0        -1.10900E-02 2.79012E-01
     16711675   -7.28184E-02 0.0         0.0         0.0         0.0
     16761680    0.0         3.43701E-02-2.01143E-02 0.0         0.0
     16811685    1.22991E 02 1.69826E-03-1.52814E 00 0.0         0.0
     16861690    0.0        -2.26512E-02-1.24214E-02 0.0         0.0
     16911695    1.14652E-01 4.32080E-01 1.68438E 01 0.0         0.0
     16961700    0.0         0.0         0.0        -1.67239E 00 4.32080E-01
     17011705   -1.68438E 01 0.0         0.0         0.0         0.0
     17061710    0.0         0.0         0.0         0.0         3.39300E 01
     17111715   -1.84699E 00-1.39385E 01 1.44786E 00-1.85312E 00 1.19524E-01
     17161720   -1.79510E-01 0.0         0.0         0.0         0.0
     17211725    5.16453E 01-1.29100E 02-4.78018E 01 0.0         0.0
     17261730    0.0         0.0         0.0        -4.71491E 01-1.29100E 02
     17311735    4.78018E 01 0.0         0.0         0.0         0.0
     17361740    0.0         0.0         0.0         0.0         0.0
     17411745   -2.24695E 00-1.32092E 01-3.07414E 01-1.85312E 00 1.19524E-01
     17461750   -1.79510E-01 0.0         0.0         0.0         0.0
     1252       0.0057
                         END OF BLADE DATA SET
       50       2016.0
     1498       5.0
                          END OF CASE   DATA                           00000550
```

TABLE 5-1 - Continued

```
INPUT DATA
CARD COLUMNS 12345678901234567890123456789012345678901234567890123456789012345678901234567890

             9999                         END OF DATA DECK                                 249
END DATA
```

TABLE 5-1 - Continued

MO-DA-YR

LIST GROUPING LIKE INPUTS

10-31-75 BELL AH-1G BLADE DATA REXOR SIMULATION MODEL GAT[illegible]

CASE = 201 THETAO= 15.0 OMEGA= 33.93 CONV. 2ND FLAP MODE

MASTER DATA

RA ADDRESS	FORTRAN NAME	VALUE	RA ADDRESS	FORTRAN NAME	VALUE	RA ADDRESS	FORTRAN NAME	VALUE	RA ADDRESS	FORTRAN NAME	VALUE	RA ADDRESS	FORTRAN NAME	VALUE
31	XCSMAX	1.000E 03	32	AZ1	1.200E 02	33	TRIMQ 1	0.0	34	TRIMQ 2	0.0	35	TRIMQ 3	0.0
36	TCUT	2.400E 01	37	**OPEN**	0.0	38	BET	0.0	39	**OPEN**	0.0	40	**OPEN**	0.0
41	**OPEN**	0.0	42	HARDSP	1.000E 00	43	**OPEN**	0.0	44	NSDATA	0.0	45	CRSFG	1.000E 00
46	ICONTR	0.0	47	IPUNCH	0.0	48	IPLOT	3.000E 00	49	IPRINT	0.0	50	CASE	2.011E 03
51	MAZ	1.800E 02	52	O	3.393E 01	53	BP	0.0	54	A1S	-2.011E-02	55	B1S	3.437E-02
56	THO	2.207E-01	57	THOTR	8.129E-02	58	ALPHA	-1.190E-02	59	PHI	-2.265E-02	60	SNGBLF	0.0
61	GINT	0.0	62	VT	1.230E 02	63	GAMMA	0.0	64	**OPEN**	0.0	65	WIMR	1.050F 01
66	PIMR	5.811E-03	67	QIMR	-1.529E-03	68	**OPEN**	0.0	69	GLCON	0.0	70	GMCON	0.0
71	WIMRD	0.0	72	PIMRD	0.0	73	QIMRD	0.0	74	WIMRN1	0.0	75	PIMRN1	0.0
76	QIMRN1	0.0	77	A1TR	3.271E-02	78	WITR	1.231E 01	79	DNWFLG	0.0	80	TAU	2.000E-02
81	R	2.200E 01	82	OB(1)	4.916E 01	83	OB(2)	3.522E 01	84	OB(3)	3.393E 01	85	TH1	-1.745E-01
86	**OPEN**	0.0	87	**OPEN**	0.0	88	**OPEN**	0.0	89	**OPEN**	0.0	90	IPITCH	0.0
91	FMASS	2.174E 02	92	ENUMZZ	0.0	93	H	1.000E 03	94	**OPEN**	0.0	95	**OPEN**	0.0
96	HF	7.850E 00	97	STR	8.500E-01	98	SLTR	2.672E 01	99	**OPEN**	0.0	100	**OPEN**	0.0
101	SLHS	1.654E 01	102	SLVS	2.508E 01	103	HVS	2.500E 00	104	EDIT	0.0	105	**OPEN**	0.0
106	ETAE	9.000E-01	107	**OPEN**	0.0	108	**OPEN**	0.0	109	RHO	2.050E-03	110	CORD	2.250E 00
111	SMALLA	0.0	112	DELTO	0.0	113	DELT2	0.0	114	FCF	0.0	115	RLF	0.0
116	FCG	0.0	117	RLG	0.0	118	IZZG	0.0	119	CHI	0.0	120	**OPEN**	0.0
121	**OPEN**	0.0	122	**OPEN**	0.0	123	QKXCS	1.780E-01	124	QKYCS	2.370E-01	125	BETAG	0.0
126	**OPEN**	0.0	127	**OPEN**	0.0	128	HUBL(1)	1.117E 00	129	HUBL(2)	1.267E 00	130	HUBL(3)	0.0
131	HUBL(4)	0.0	132	HUBL(5)	0.0	133	NGORF	0.0	134	CYCFLG	0.0	135	DEODA	4.500E-01
136	E	-7.500E-01	137	OKGZ1	0.0	138	QCGZ	0.0	139	GMASS	0.0	140	QKGZ2	0.0
141	ZG1	0.0	142	CORAF	4.000E 00	143	TURNLF	1.000E 00	144	TURNSN	-1.000E 00	145	C1I1	0.0
146	C1F1	-5.000E-01	147	**OPEN**	0.0	148	C2F1	0.0	149	**OPEN**	0.0			
271	DOEO	1.000E 00	272	DOE1	0.0	273	FKSPT	0.0	274	YTR	-1.237E 00			
287	TC(1)	3.000E-01	288	TC(2)	5.000E-02	289	TC(3)	1.000E-01	290	TC(4)	1.000E-02	291	TC(5)	0.0
292	TCX	2.500E-02	293	TCY	2.500E-02	294	TXS	0.0	295	PRI	0.0	296	QRI	0.0
297	DSTAF	1.650E 01												
341	**OPEN**	0.0	342	QKXCSG	0.0	343	QKYCSG	0.0	344	PSIPG	0.0	345	CHIG	0.0
346	ZOBL	3.750E-01	347	MUB	0.0	348	PXPZ	0.0	349	PYPZ	0.0	350	IZZGR	0.0
351	TAUCT	1.000E 00	352	GSKL	0.0	353	GSDL	0.0	354	GFDDL	0.0	355	GSKM	0.0
356	GSDM	0.0	357	GFKDM	0.0	358	GFDDM	0.0	359	GKKDL	0.0	360	IZZGNR	0.0
361	IXXG	0.0	362	GKK	0.0	363	GRD	0.0	364	XTHTF	-1.600E 00	365	YPHIF	1.600E 00
366	HMASS	8.900E 00	367	**OPEN**	0.0	368	**OPEN**	0.0	369	**OPEN**	0.0	370	**OPEN**	0.0
371	CLAG	0.0	372	[illegible]BAR	0.0	373	YFBAR	0.0	374	ZFBAR	-1.160E 00	375	FKS	9.168E 05
376	KPHCON	1.000E 00	377	KTHCON	1.000E 00	378	CPHDSP	0.0	379	CTHDSP	0.0			
395	KFPHG	0.0	396	RFBL	0.0	397	PSIFBL	0.0	398	CAPHIS	0.0	399	IFLEX	1.000E 00
437	XCPDL	1.500E 00	438	YCPDL	1.000E 00	439	**OPEN**	0.0	440	FAST	0.0			
490	IAMCS	0.0	491	**OPEN**	0.0	492	**OPEN**	0.0	493	**OPEN**	0.0	494	YCSMAX	1.000E 03
495	**OPEN**	0.0	496	**OPEN**	0.0	497	**OPEN**	0.0						
581	VEQ1	0.0	582	DVEQ1	0.0	583	VEQ2	0.0	584	DVEQ2	0.0	585	KXCS	0.0
586	KYCS	0.0	587	KXPR	0.0	588	XCS1	0.0	589	XCS2	0.0	590	YCS1	0.0
591	POENG	0.0	592	PQEUM	0.0	593	K1 PRM	0.0	594	K2 PRM	0.0	595	TAUG	0.0
596	**OPEN**	0.0	597	**OPEN**	0.0	598	**OPEN**	0.0	599	**OPEN**	0.0	600	**OPEN**	0.0

TABLE 5-1 - Continued

MASTER DATA (CONTINUED)

661	GLCN	0.0	662	GMCN	0.0	663	TEETER	1.000E 00	664	APHI	0.0	665	BPHI	0.0
666	APSI	0.0	667	BPSI	0.0	668	ATH	0.0	669	BTH	0.0	670	ATC	0.0
671	**OPEN**	0.0	672	**OPEN**	0.0	673	**OPEN**	0.0	674	**OPEN**	0.0	675	**OPEN**	0.0
676	**OPEN**	0.0	677	**OPEN**	0.0	678	**OPEN**	0.0	679	**OPEN**	0.0			
1241	K11	4.582E 03	1242	K21	-3.925E 00	1243	K31	0.0	1244	K12	-3.925E 00	1245	K22	1.660E 02
1246	K32	0.0	1247	K13	0.0	1248	K23	0.0	1249	K33	0.0	1250	CTRIM	5.700E-04
1251	CFLY	5.700E-04	1252	CZERO	5.700E-03	1253	CONK	0.0	1254	**OPEN**	0.0	1255	**OPEN**	0.0
1256	DCMR	0.0	1257	IHAFLG	1.000E 00	1258	**OPEN**	0.0	1259	**OPEN**	0.0	1260	**OPEN**	0.0
1261	**OPEN**	0.0	1262	IHAPLT	0.0	1263	DGDHG	0.0	1264	DELCD	0.0	1265	**OPEN**	0.0
1266	CONE	2.750E 00	1267	SWEEP	0.0	1268	GROOP	0.0	1269	PHIREF	1.500E 01	1270	BFAS	2.750E 00
1271	**OPEN**	0.0	1272	**OPEN**	0.0	1273	**OPEN**	0.0	1274	**OPEN**	0.0	1275	**OPEN**	0.0
1276	GASTOP	0.0	1277	GKSTOP	0.0	1278	RRK	0.0	1279	TWTR	5.000E 00	1280	TCTRA	3.500E-02
1281	**OPEN**	0.0	1282	**OPEN**	0.0	1283	**OPEN**	0.0	1284	**OPEN**	0.0	1285	**OPEN**	0.0
1286	MFREQ	0.0	1287	**OPEN**	0.0	1288	**OPEN**	0.0	1289	**OPEN**	0.0	1290	**OPEN**	0.0
1291	SS	1.098E 03	1292	**OPEN**	0.0	1293	**OPEN**	0.0	1294	**OPEN**	0.0	1295	**OPEN**	0.0
1296	**OPEN**	0.0	1297	**OPEN**	0.0	1298	**OPEN**	0.0	1299	**OPEN**	0.0	1300	IBLADE	0.0
1341	DCOEF 1	0.0	1342	DCOEF 2	0.0	1343	DCOEF 3	0.0	1344	DCOEF 4	0.0	1345	KTI	0.0
1346	KTD	0.0	1347	DCMR1	0.0	1348	HTR	5.356E 00	1349	YP	0.0	1350	THRCON	0.0
1351	TORCON	0.0	1352	PARCON	0.0	1353	**OPEN**	0.0	1354	**OPEN**	0.0	1355	**OPEN**	0.0
1356	**OPEN**	0.0	1357	**OPEN**	0.0	1358	**OPEN**	0.0	1359	**OPEN**	0.0	1360	**OPEN**	0.0
1401	TCT	0.0	1402	DTH1	0.0	1403	DTH2	0.0	1404	TTFLAG	0.0	1405	**OPEN**	0.0
1406	**OPEN**	0.0	1407	**OPEN**	0.0	1408	**OPEN**	0.0	1409	YIV1	0.0	1410	YIV2	0.0
1411	YIV3	0.0	1412	ZIV1	0.0	1413	ZIV2	0.0	1414	ZIV3	0.0	1415	YOV1	0.0
1416	YOV2	0.0	1417	YOV3	0.0	1418	ZOV1	0.0	1419	ZOV2	0.0	1420	ZOV3	0.0
1461	IXXF	1.559E 03	1462	IYYF	1.117E 04	1463	IZZF	8.759E 03	1464	IXYF	4.000E 02	1465	IXZF	5.800E 02
1466	IYZF	0.0	1467	**OPEN**	0.0	1468	IZZH	0.0	1469	ZGS	0.0	1470	IXXPRO	0.0
1471	IXXENG	2.000E 01	1472	IYYTR	2.800E 00	1473	GRPRO	1.000E 00	1474	GRENG	2.040E 01	1475	GRTR	5.120E 00
1476	**OPEN**	0.0	1477	ZBPH	7.500E-01	1478	AKPH	0.0	1479	DELZOR	0.0	1480	IPHORN	0.0
1481	YJOG	0.0	1482	ZJOG	0.0	1483	IFFT	0.0	1484	ENGHPX	0.0	1485	CFB	0.0
1486	**OPEN**	0.0	1487	KPH	0.0	1488	TPH	0.0	1489	**OPEN**	0.0	1490	**OPEN**	0.0
1491	RTWANG1	0.0	1492	RTWANG2	0.0	1493	RTWANG3	0.0	1494	FIDDLE	0.0	1495	**OPEN**	0.0
1496	**OPEN**	0.0	1497	TORFLG	0.0	1498	TSTOP	2.000E 00	1499	IDECUP	0.0	1500	**OPEN**	0.0

TABLE 5-1 - Continued

MASTER DATA (CONTINUED)

2481	**OPEN**	0.0	2482	**OPEN**	0.0	2483	**OPEN**	0.0	2484	**OPEN**	0.0	2485	**OPEN**	0.0
2486	**OPEN**	0.0	2487	**OPEN**	0.0	2488	**OPEN**	0.0	2489	**OPEN**	0.0	2490	**OPEN**	0.0
2491	**OPEN**	0.0	2492	LFB	0.0	2493	**OPEN**	0.0	2494	**OPEN**	0.0	2495	**OPEN**	0.0
2496	**OPEN**	0.0	2497	**OPEN**	0.0	2498	**OPEN**	0.0	2499	**OPEN**	0.0	2500	**OPEN**	0.0
2501	**OPEN**	0.0	2502	**OPEN**	0.0	2503	**OPEN**	0.0	2504	**OPEN**	0.0	2505	**OPEN**	0.0
2506	**OPEN**	0.0	2507	**OPEN**	0.0	2508	**OPEN**	0.0	2509	**OPEN**	0.0	2510	**OPEN**	0.0
2511	**OPEN**	0.0	2512	**OPEN**	0.0	2513	**OPEN**	0.0	2514	XSTDIF	0.0	2515	FLAP2	0.0
2516	PSIFB	0.0	2517	**OPEN**	0.0	2518	**OPEN**	0.0	2519	**OPEN**	0.0	2520	**OPEN**	0.0
2521	**OPEN**	0.0	2522	ZRMI 1	0.0	2523	ZRMI 2	0.0	2524	ZRMI 3	0.0	2525	**OPEN**	0.0
2526	**OPEN**	0.0	2527	**OPEN**	0.0	2528	ZRMPI 1	0.0	2529	ZRMPI 2	0.0	2530	ZRMPI 3	0.0
2531	**OPEN**	0.0	2532	**OPEN**	0.0	2533	**OPEN**	0.0	2534	**OPEN**	0.0	2535	**OPEN**	0.0
2536	**OPEN**	0.0	2537	**OPEN**	0.0	2538	**OPEN**	0.0	2539	**OPEN**	0.0	2540	**OPEN**	0.0
2541	**OPEN**	0.0	2542	**OPEN**	0.0	2543	**OPEN**	0.0	2544	**OPEN**	0.0	2545	KFBG	0.0
2546	ZJLIM	0.0	2547	RFB	0.0	2548	**OPEN**	0.0	2549	DPHIS	3.283E 03	2550	DTHTS	3.283E 03
2551	PSLOPL	0.0	2552	TSLOPL	0.0	2553	TCUTO	0.0	2554	TCUT3	0.0	2555	ISTALL	0.0
2556	**OPEN**	0.0	2557	**OPEN**	0.0	2558	**OPEN**	0.0	2559	FACTM	5.000E-01	2560	IHA	0.0
2561	QMCON 1	0.0	2562	QMCON 2	0.0	2563	QMCON 3	0.0	2564	QMCON 4	0.0	2565	QMCON 5	0.0
2566	QMCON 6	0.0	2567	**OPEN**	0.0	2568	**OPEN**	0.0	2569	**OPEN**	0.0	2570	STA70	0.0
2571	GAIN1	0.0	2572	GAIN1	0.0	2573	GAIN1	0.0	2574	GAIN1	0.0	2575	GAIN1	0.0
2576	GAIN1	0.0	2577	GAIN1	0.0	2578	GAIN1	0.0	2579	GAIN1	0.0	2580	GAIN1	0.0
2581	GAIN1	0.0	2582	GAIN1	0.0	2583	GAIN1	0.0	2584	GAIN1	0.0	2585	GAIN1	0.0
2586	GAIN1	0.0	2587	GAIN1	0.0	2588	GAIN1	0.0	2589	GAIN1	0.0	2590	**OPEN**	0.0
2591	**OPEN**	0.0	2592	**OPEN**	0.0	2593	**OPEN**	0.0	2594	**OPEN**	0.0	2595	**OPEN**	0.0
2596	**OPEN**	0.0	2597	**OPEN**	0.0	2598	**OPEN**	0.0	2599	**OPEN**	0.0	2600	**OPEN**	0.0
2681	AWING	2.780E 01	2682	CWING	2.670E 00	2683	AOTR	5.960F 00	2684	RTR	4.250E 00	2685	A	5.730E 00
2686	B	9.400E-01	2687	**OPEN**	0.0	2688	CUTOUT	5.000E 00	2689	ILOOK	0.0	2690	IFOIL	0.0
1901	B(1)	0.0	1902	B(2)	0.0	1903	B(3)	0.0	1904	B(4)	0.0	1905	B(5)	0.0
1906	B(6)	0.0	1907	B(7)	0.0	1908	A(1)	0.0	1909	A(2)	0.0	1910	A(3)	0.0
1911	A(4)	0.0	1912	A(5)	0.0	1913	A(6)	0.0	1914	A(7)	0.0	1915	A(8)	0.0
1916	A(9)	0.0	1917	A(10)	0.0	1918	A(11)	0.0	1919	A(12)	0.0	1920	A(13)	0.0
1921	A(14)	0.0	1922	A(15)	0.0	1923	A(16)	0.0	1924	A(17)	0.0	1925	A(18)	0.0
1926	A(19)	0.0	1927	A(20)	0.0	1928	A(21)	0.0	1929	A(22)	0.0	1930	Z(1)	0.0
1931	Z(2)	0.0	1932	Z(3)	0.0	1933	Z(4)	0.0	1934	Z(5)	0.0	1935	Z(6)	0.0
1936	HPSET	0.0	1937	**OPEN**	0.0	1938	**OPEN**	0.0	1939	TMAUTO	0.0	1940	NPT	0.0
1941	T	0.0	1942	T	0.0	1943	T	0.0	1944	T	0.0	1945	T	0.0
1946	T	0.0	1947	T	0.0	1948	T	0.0	1949	T	0.0	1950	T	0.0
1951	T	0.0	1952	T	0.0	1953	T	0.0	1954	T	0.0	1955	T	0.0
1956	T	0.0	1957	T	0.0	1958	T	0.0	1959	T	0.0	1960	T	0.0
1961	E	0.0	1962	E	0.0	1963	E	0.0	1964	E	0.0	1965	E	0.0
1966	E	0.0	1967	E	0.0	1968	E	0.0	1969	E	0.0	1970	E	0.0
1971	E	0.0	1972	E	0.0	1973	E	0.0	1974	E	0.0	1975	E	0.0
1976	E	0.0	1977	E	0.0	1978	E	0.0	1979	E	0.0	1980	E	0.0
1981	GAIN(1)	-2.000E-03	1982	GAIN(2)	1.500E-02	1983	GAIN(3)	-8.000E-04	1984	GAIN(4)	3.000E-03	1985	GAIN(5)	-2.500E-02
1986	GAIN(6)	-3.750E-02	1987	GAIN(7)	0.0	1988	GAIN(8)	0.0	1989	GAIN(9)	0.0	1990	GAIN(10)	0.0
1991	GAIN(11)	0.0	1992	GAIN(12)	0.0	1993	GAIN(13)	0.0	1994	GAIN(14)	0.0	1995	GAIN(15)	0.0
1996	GAIN(16)	0.0	1997	GAIN(17)	0.0	1998	GAIN(18)	0.0	1999	GAIN(19)	0.0	2000	TRMUPD	0.0

TABLE 5-1 - Continued

AERODYNAMIC DATA

START RA ADDRESS OF GROUPING

ALFA	2601										
		-1.800E 02	-1.600E 01	-1.400E 01	-1.200E 01	-1.000E 01	-8.000E 00	-6.000E 00	-4.000E 00	-2.000E 00	0.0
		2.000E 00	4.000E 00	6.000E 00	8.000E 00	1.000E 01	1.200E 01	1.400E 01	1.600E 01	1.800E 01	1.800E 02
CL	2621										
		0.0	-3.040E-01	-2.850E-01	-2.650E-01	-2.460E-01	-2.260E-01	-2.060E-01	-1.860E-01	-1.670E-01	-1.470E-01
		-1.280E-01	-1.080E-01	-8.900E-02	-6.900E-02	-4.900E-02	-2.800E-02	-1.100E-02	9.000E-03	2.900E-02	0.0
CM	2641										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CD	2661										
		5.000E-01	3.530E-01	3.200E-01	2.920E-01	2.670E-01	2.460E-01	2.280E-01	2.140E-01	2.040E-01	1.970E-01
		1.940E-01	1.940E-01	1.980E-01	2.060E-01	2.170E-01	2.320E-01	2.500E-01	2.720E-01	2.980E-01	5.000E-01
FX	1751										
		1.800E 01	-1.800E 02	6.230E-01	0.0	6.230E-01	4.000E 01	7.400E-01	7.000E 01	8.800E-01	8.000E 01
		8.600E-01	9.000E 01	8.400E-01	1.000E 02	5.600E-01	1.100E 02	3.830E-01	1.800E 02	3.830E-01	0.0
		0.0	0.0	0.0	0.0	0.0					
TMBODY	1776										
		2.200E 01	-1.800E 02	0.0	2.000E 01	0.0	5.000E 01	2.000E 00	6.000E 01	1.920E 00	7.400E 01
		1.520E 00	8.000E 01	1.340E 00	9.000E 01	1.140E 00	1.000E 02	1.080E 00	1.100E 02	1.040E 00	1.200E 02
		9.600E-01	1.800E 02	0.0	0.0	0.0					

TABLE 5-1 - Continued

PILOT CONTROL TABLES

150 NMP 4.000E 00 (RA(150)) - NMP = 4

START RA ADDRESS OF GROUPING

PT	151										
		0.0	2.000E 00	2.010E 00	8.000E 00	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PXCS	171										
		0.0	0.0	4.200E-02	4.200E-02	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PYCS	191										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PTHO	211										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PTHOTR	231										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PBP	251										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PSITB	641										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TTB	1501										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 5-1 - Continued

```
PLOT DATA

 298 TSCLE     1.000E 00   299 NVAR1     3.200E 01   300 NVAR2      4.500E 01   134 CYCFLG    0.0
                             START RA ADDRESS OF GROUPING
NVEC1       301
                1.000E 00  2.000E 00  3.000E 00  4.000E 00  1.000E 01  1.100E 01  1.200E 01  5.000E 00  8.000E 00  9.000E 00
                6.000E 00  7.900E 01  5.300E 01  5.500E 01  5.600E 01  8.000E 01  1.300E 01  9.000E 01  8.100E 01  4.700E 01
                7.000E 00  8.500E 01  8.600E 01  8.700E 01  8.800E 01  8.900E 01  1.400E 01  1.500E 01  5.100E 01  5.200E 01
                1.600E 01  1.700E 01  0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0

NVEC2      1801
                3.000E 00  7.000E 00  2.100E 01  1.400E 01  5.400E 01  4.000E 00  1.600E 01  1.500E 01  1.800E 01  1.900E 01
                1.700E 01  1.300E 01  2.900E 01  2.800E 01  2.700E 01  2.600E 01  3.000E 01  2.500E 01  2.400E 01  2.300E 01
                3.600E 01  1.000E 00  2.000E 00  4.000E 01  4.200E 01  5.200E 01  5.100E 01  4.700E 01  7.100E 01  6.900E 01
                7.000E 01  6.800E 01  3.100E 01  3.200E 01  3.900E 01  4.500E 01  4.400E 01  5.000E 01  4.900E 01  5.600E 01
                5.500E 01  5.300E 01  4.100E 01  5.800E 01  5.700E 01  0.0        0.0        0.0        0.0        0.0

SVEC       1851
                0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
                0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
                0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
                0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
                0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
```

TABLE 5-1 - Continued

FUESELAGE,WING,TAIL AERO TABLE W/WIND AXIS 441- 476 FNM ARRAY

0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	-1.783E-01	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	-6.980E-02	0.0	-1.154E 00	0.0
0.0	-8.846E-02	0.0	0.0	0.0	2.218E 00

BLADE DATA

498 NRAD 1.300E 01 499 NINC 1.000E 00 500 KSTART 2.000E 00

SX 501

1.000E 00	2.250E 00	4.250E 00	6.000E 00	7.500E 00	9.500E 00	1.075E 01	1.250E 01	1.475E 01	1.700E 01
1.900E 01	2.025E 01	2.200E 01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SY 601

-1.168E-02	-2.234E-01	-1.460E-01	-1.035E-01	-1.370E-01	-1.214E-01	-9.380E-02	7.268E-03	9.929E-02	-2.587E-03
4.461E-03	1.857E-01	2.042E-01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

YNA 1521

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

M(S) 541

2.306E 00	1.676E 00	1.122E 00	3.360E-01	2.132E-01	2.634E-01	2.086E-01	2.988E-01	3.793E-01	2.150E-01
1.879E-01	4.950E-01	9.483E-01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BLADE POLAR INERTIA

BI 1301

1.841E-01	7.895E-02	1.572E-01	1.269E-01	9.224E-02	1.176E-01	9.498E-02	9.296E-02	8.246E-02	6.992E-02
6.680E-02	7.288E-02	1.044E-01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 5-1 - Continued

BLADE MODE SHAPE TABLES

INPLANE

761 - 800 ← RA RANGE

0.0	1.500E-02	5.995E-02	1.178E-01	1.987E-01	2.720E-01	3.354E-01	4.296E-01	5.576E-01	6.916E-01
8.140E-01	8.914E-01	1.000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

801 - 840

0.0	-6.531E-02	-1.236E-01	-1.463E-01	-1.442E-01	-1.229E-01	-1.055E-01	-7.897E-02	-4.386E-02	-8.914E-03
2.117E-02	3.922E-02	6.403E-02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

841 - 880

0.0	1.413E-02	2.796E-02	3.687E-02	4.324E-02	4.910E-02	5.193E-02	5.515E-02	5.829E-02	6.051E-02
6.167E-02	6.196E-02	6.206E-02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

881 - 920

0.0	-3.386E-02	-2.387E-02	-6.298E-03	5.329E-03	1.246E-02	1.426E-02	1.514E-02	1.538E-02	1.508E-02
1.449E-02	1.424E-02	1.415E-02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 5-1 - Continued

BLADE MODE SHAPE TABLES

1ST FLAP

921 - 960									
0.0	3.196E-04	1.818E-03	4.222E-03	7.048E-03	1.153E-02	1.456E-02	1.900E-02	2.493E-02	3.105E-02
3.659E-02	4.007E-02	4.495E-02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
961 - 1000									
0.0	7.052E-02	1.536E-01	2.302E-01	2.989E-01	3.932E-01	4.529E-01	5.372E-01	6.462E-01	7.558E-01
8.534E-01	9.145E-01	1.000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1001 - 1040									
0.0	4.426E-04	1.002E-03	1.621E-03	2.039E-03	2.348E-03	2.466E-03	2.582E-03	2.681E-03	2.748E-03
2.780E-03	2.789E-03	2.792E-03	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1041 - 1080									
0.0	4.079E-02	4.233E-02	4.470E-02	4.636E-02	4.752E-02	4.793E-02	4.828E-02	4.857E-02	4.876E-02
4.885E-02	4.887E-02	4.888E-02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

2ND FLAP

1081 - 1120									
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1121 - 1160									
0.0	1.023E-01	1.932E-01	2.727E-01	3.409E-01	4.318E-01	4.886E-01	5.682E-01	6.705E-01	7.727E-01
8.636E-01	9.205E-01	1.000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1161 - 1200									
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1201 - 1240									
4.550E-02	4.545E-02	4.545E-02	4.545E-02	4.545E-02	4.545E-02	4.545E-02	4.545E-02	4.545E-02	4.545E-02
4.545E-02	4.545E-02	4.545E-02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 5-1 - Continued

FEATHERING BEARING LOCATIONS		Y-IN	Z-IN	Y-OUT	Z-OUT
275 - 278	INPLANE	3.712E-03	-2.065E-02	1.695E-02	-6.983E-02
279 - 282	1ST FLAP	8.399E-05	2.418E-02	3.800E-04	7.596E-02
283 - 286	2ND FLAP	0.0	5.076E-02	0.0	1.083E-01

TABLE 5-1 - Continued

TORSION DATA

YSC	1421										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DSOWJ	1361										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PPTOR	2871										
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 5-1 - Continued

INITIAL CONDITIONS

THTORS 2001

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

THTRD 2161

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

THG1 2321

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 5-1 - Continued

Y	1661										
		-9.128E-02	2.790E-01	7.282E-02	0.0	0.0	0.0	0.0	0.0	-1.109E-02	2.790E-01
		-7.282E-02	0.0	0.0	0.0	0.0	0.0	3.437E-02	-2.011E-02	0.0	0.0
		1.230E 02	1.698E-03	-1.528E 00	0.0	0.0	0.0	-2.265E-02	-1.242E-02	0.0	0.0
YD	1691										
		1.147E-01	4.321E-01	1.684E 01	0.0	0.0	0.0	0.0	0.0	-1.672E 00	4.321E-01
		-1.684E 01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.393E 01
		-1.847E 00	-1.394E 01	1.448E 00	-1.853E 00	1.195E-01	-1.795E-01	0.0	0.0	0.0	0.0
YDD	1721										
		5.165E 01	-1.291E 02	-4.780E 01	0.0	0.0	0.0	0.0	0.0	-4.715E 01	-1.291E 02
		4.780E 01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-2.247E 00	-1.321E 01	-3.074E 01	-1.853E 00	1.195E-01	-1.795E-01	0.0	0.0	0.0	0.0
DPF	2801										
		0.0	0.0	0.0	0.0						
DPFD	2805										
		0.0	0.0	0.0	0.0						
DPF1	2809										
		0.0	0.0	0.0	0.0						
DPF2	2813										
		0.0	0.0	0.0	0.0						

TABLE 5-1 - Continued

10-31-75 BELL AH-1G BLADE DATA REXOR SIMULATION MODEL GAIDE

CASE = 201 THETAO= 15.0 OMEGA= 33.93 CINV. 2ND FLAP MODF

LIST OF CHANGES TO MASTER DATA

50	CASE	2.016E 03
1498	TSTOP	5.000E 00

GLSK	GLSD	GLDK	GLDD	GMSK	GMSD	GMDK	GMDD
1.00000E 00	0.0	0.0	0.0	0.0	1.00000E 00	0.0	0.0

TABLE 5-1 - Continued

CASE 2016. MO-DA-YR TRIM DATA

BEGIN THE TRIMMING PROCESS

• ELAPSED TIME • SIN (ψ_{BL2}) • TRUE AIRSPEED • PITCH SHAFT BEND	• TIME DERIVATIVES OF HUB VELOCITIES	• HUB ANGULAR ACCELERATIONS	• HUB EULER ANGLES IN EARTH AXES	• COLLECTIVE AND CYCLIC ANGLES	• TAIL ROTOR COLL. • PROP BLADE ANGLE • ENGINE TORQUE	• VERTICAL DNWS • ROLL DOWNWASH • PITCH DOWNWASH	• FLT PATH ANGLE • SIDESLIP • ROLL SHAFT BEND
TIME SCY VT THT S	UFD VFD WFD	PRD QRD RRD	PHI THETA ALPHA	THO A1S B1S	THOTR BP MZZEND	WIMR PIMR QIMR	GAMMA BETA PHI S
0.0	-1.09505E 00	-1.50310E 00	-2.26512E-02	2.20736E-01	8.12860E-02	1.05046E 01	0.0
0.0	3.47742E-01	1.83067E-01	-1.19007E-02	-2.01143E-02	0.0	5.81150E-03	0.0
1.23000E 02	1.58839E 00	-2.33442E-02	-1.19030E-02	3.43701E-02	5.59682E 03	-1.52924E-03	0.0
0.0							
LD(1)	LD(2)	ETC	FUSELAGE, TAIL ROTOR AND PROP LOADS, FUSELAGE AXES; X, Y AND Z FORCES THEN X, Y AND Z MOMENTS				
-9.79805E 01	2.62734E 02	1.20164E 02	1.40721E 03	5.76849E 02	-7.03682E 03		
THF		FEATHER ANGLES, PLUS NOSE UP, BLADES 1, 2, 3 AND 4					
2.46441E-01	0.0	2.06213E-01	0.0				
TFA		FEATHER TORQUES, PLUS NOSE DOWN, BLADES 1, 2, 3 AND 4					
7.63172E 02	0.0	6.41532E 02	0.0				
F			BLADE 1 ROOT INTEGRALS, SEE PROGRAM				
-4.06880E 02	-6.11958E 01	-1.88827E 03	-1.09606E 05	-1.51154E 03	-3.19895E 03	5.14221E 02	-7.38262E 02
7.98696E 03	3.49118E 02	-3.18722E 02	-4.31386E 03	3.37028E 02	-6.64270E 04	4.78559E 03	3.97074E 02
0.0	6.93338E 02	2.20400E 00	-2.28551E-01	-1.60947E-02	-2.23261E-02	2.33088E 00	3.08543E-02
-8.80127E-02	2.72699E 00	2.79666E 00	2.88243E 00	5.49310E 01	2.31943E 00	-1.33705E-02	-2.31277E 00
-1.41560E-02	1.40013E-01	-2.56503E-02	3.26447E 00	1.38812E-01	-3.91397E-05	5.82342E-02	6.20697E-01
-4.06876E 00	-4.34055E 00	-6.65065E-01	1.90433E 00	4.02299E-02	-3.06848E-02	-2.27190E 00	-1.94181E 00
6.15459E 01	6.33766E 01	-4.95335E-01	4.47648E 01	-8.64985E-03	9.54427E 01	-9.43303E-01	2.87760E 00
-6.90419E 01	-2.94711E 03	-3.01540E 03	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
FF	← ROTOR AERO PLUS INERTIAL LOADS IN STATIONARY HUB AXES →					← ROTOR AERO ONLY LOADS IN HUB AXES →	
-3.56750E 02	-7.38895E 02	-7.09257E 03	-3.95529E 02	-3.68484E 03	6.17154E 03	-3.74216E 01	-1.90967E 02
-8.80691E 03	9.06030E 01	4.78250E 02	6.87298E 03				
FN		FUSELAGE AERO LOADS IN FUSELAGE AXES					
-9.93240E 01	0.0	1.39332E 02	0.0	5.38710E 02	0.0		

TABLE 5-1 - Continued

CASE 2016.		MO-DA-YR					
Y(I)			DISPLACEMENT OF EACH DEGREE OF FREEDOM				
-9.12822E-02	2.79012E-01	7.28164E-02	0.0	0.0	0.0	0.0	0.0
-1.10900E-02	2.79012E-01	-7.28164E-02	0.0	0.0	0.0	0.0	0.0
3.43701E-02	-2.01143E-02	0.0	0.0	1.22991E 02	0.0	-1.46413E 00	0.0
0.0	0.0	-2.26512E-02	-1.19007E-02	0.0	0.0		
YD(I)			VELOCITY OF EACH DEGREE OF FREEDOM				
1.14652E-01	4.32060E-01	1.68438E 01	0.0	0.0	0.0	0.0	0.0
-1.67239E 00	4.32080E-01	-1.68438E 01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	3.39300E 01	-2.55213E 00	-1.14516E 01	1.58839E 00	-1.50310E 00
1.83067E-01	-2.33442E-02	0.0	0.0	0.0	0.0		
YDD(I)			ACCELERATION OF EACH DEGREE OF FREEDOM				
5.45909E 01	-1.35148E 02	-7.96472E 01	0.0	0.0	0.0	0.0	0.0
-2.13799E 01	-1.35148E 02	7.96472E 01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	-2.91533E 00	-1.07222E 01	-3.06010E 01	-1.50310E 00
1.83067E-01	-2.33442E-02	0.0	0.0	0.0	0.0		
ZDD		ADDITIONAL ACCELERATIONS; CONTROL GYRO ROLL AND PITCH, SHAFT BENDING ROLL AND PITCH					
0.0	0.0	0.0	0.0				
0.0	0.0						
QFG(I)			TOTAL GENERALIZED FORCE OF EACH DEGREE OF FREEDOM				
9.48498E 00	-1.52984E 01	-9.17369E 01	0.0	0.0	0.0	0.0	0.0
5.48327E 01	-1.52864E 01	9.17369E 01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	-3.67994E 02	-6.41227E 02	3.13666E 02	1.00869E 01
-3.31969E 03	-8.65281E 02	-1.05660E 03	-4.56743E 02	0.0	0.0		

TABLE 5-1 - Continued

CASE 2016. MO-DA-YR DATA AT END OF TRIM

TIME SCY VT TNT S	UFD VFD WFD	PRD QRD RRD	PHI THETA ALPHA	THO AIS BIS	THOTR BP MZZEND	WIMR PIMR QIMR	GAMMA BETA PHI S
1.85173E 00	-1.21325E 00	-1.71779E 00	-2.08819E-02	2.21223E-01	8.24854E-02	1.04813E 01	0.0
-6.46561E-05	6.34453E-01	1.62452E-01	-6.71033E-03	-2.17537E-02	0.0	1.73913E-03	0.0
1.23000E 02	1.52095E 00	-2.19028E-01	-6.21604E-03	4.21393E-02	4.96630E 03	-8.26800E-04	-1.17696E-03
-4.95619E-04							
LD							
-9.80288E 01	2.66412E 02	1.18633E 02	1.42690E 03	5.89097E 02	-7.13555E 03		
THF							
2.48608E-01	0.0	2.05097E-01	0.0				
TFA							
7.82895E 02	0.0	8.29450E 02	0.0				
F							
-3.88635E 02	-4.70796E 01	-1.87354E 03	-1.09590E 05	-1.47965E 03	-4.16262E 03	4.80421E 02	-4.27789E 02
7.50600E 03	3.86018E 02	-3.32003E 02	-4.29754E 03	2.88707E 02	-6.62531E 04	4.98758E 03	4.11101E 02
0.0	7.07875E 02	2.20399E 00	-2.19509E-01	-2.35562E-02	-3.03212E-02	2.33971E 00	2.77727E-02
-9.21013E-02	2.72812E 00	2.79751E 00	2.88299E 00	5.50306E 01	2.34005E 00	-1.24440E-02	-2.08791E 00
-2.07111E-02	1.76329E-01	1.31923E-02	3.27062E 00	1.40068E-01	1.30956E-05	7.29071E-02	6.25801E-01
-4.06828E 00	-4.34055E 00	-8.54359E-01	2.39824E 00	6.82139E-02	-2.40728E-02	-2.28389E 00	-2.03380E 00
6.15549E 01	6.33799E 01	-6.70101E-01	5.71676E 01	2.60708E-03	9.54480E 01	-9.28928E-01	3.72897E 00
-7.33318E 01	-2.94010E 03	-3.00718E 03	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
FF							
-3.37063E 02	-7.20072E 02	-7.07505E 03	-4.04618E 02	-3.30262E 03	5.55397E 03	4.19055E 01	-2.11106E 02
-8.77393E 03	3.64053E 01	3.95109E 02	6.96670E 03				
FN							
-9.89507E 01	0.0	1.37556E 02	0.0	5.49978E 02	0.0		

TABLF 5-1 - Continued

CASE 2016.	MO-DA-YR						
Y(I)							
-8.70064E-02	2.80888E-01	-1.24890E-01	0.0	0.0	0.0	0.0	0.0
-1.01421E-02	2.80888E-01	1.24890E-01	0.0	0.0	0.0	0.0	0.0
4.21393E-02	-2.17537E-02	0.0	0.0	1.22997E 02	8.99865E-04	-8.25526E-01	0.0
0.0	0.0	-2.08819E-02	-6.71033E-03	0.C	0.0		
YD(I)							
2.08876E-01	4.30547E-01	1.52244E 01	0.0	0.0	0.0	0.0	0.0
-1.74088E 00	4.30547E-01	-1.52244E 01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	3.39300E 01	-2.48936E 00	-1.28526E 01	1.51918E 00	-1.71790E 00
1.62710E-01	-2.17985E-01	0.0	0.0	0.0	0.0		
YDD(I)							
3.30462E 01	-1.33745E 02	1.47263E 02	0.0	0.0	0.0	0.0	0.0
-5.23389E 01	-1.33745E 02	-1.47263E 02	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	-2.70543E 00	-1.21803E 01	-3.06731E 01	-1.71790E 00
1.62710E-01	-2.17985E-01	0.0	0.0	0.0	0.0		
ZDD							
0.0	0.0	0.0	0.0				
0.0	0.0						
QFG(I)							
1.05856E 01	-9.86240E 00	-8.24744E 01	0.0	0.0	0.0	0.0	0.0
1.48694E 01	-9.86240E 00	8.24744E 01	0.0	(0	0.0	0.0	0.0
0.0	0.0	C.0	0.0	-3.86125E 02	-6.05982E 02	3.30644E 02	-1.49636E 02
-3.18354E 03	-1.58156E 03	1.76931E 01	-5.41261E 00	0.0	0.0		

TABLE 5-1 - Continued

CASE 2016. MO-DA-YR DATA AT END OF ADDITIONAL REVOLUTION FOR HARMONIC ANALYSIS

TIME	UFD	PRD	PHI	THO	THOTR	WIMR	GAMMA
SCY	VFD	QRD	THETA	AIS	BP	PIMR	BETA
VT	WFD	RRD	ALPHA	BIS	MZZEND	QIMR	PHI S
THT S							
2.03690E 00	-1.10748E 00	-1.72698E 00	-2.08819E-02	2.21223E-01	8.24854E-02	1.05038E 01	0.0
-7.08327E-05	6.43026E-01	1.44833E-01	-6.71033E-03	-2.17537E-02	0.0	5.39862E-03	0.0
1.23000E 02	1.43921E 00	-2.07834E-01	-6.21604E-03	4.21393E-02	5.10947E 03	-1.55255E-03	-1.17696E-03
-4.95619E-04							
LD							
-9.79629E 01	2.66981E 02	1.18758E 02	1.42995E 03	5.89986E 02	-7.15070E 03		
THF							
2.48564E-01	0.0	2.05053E-01	0.0				
TFA							
7.79725E 02	0.0	6.33338E 02	0.0				
F							
-3.66160E 02	3.00361E 01	-1.79506E 03	-1.09559E 05	-1.37717E 03	-3.89945E 03	5.16096E 02	1.29079E 03
6.73510E 03	3.80744E 02	-3.30039E 02	-4.30328E 03	2.92295E 02	-6.63305E 04	4.95883E 03	4.04751E 02
0.0	7.04645E 02	2.20402E 00	-2.21516E-01	-2.22549E-02	-2.89072E-02	2.33954E 00	2.78181E-02
-9.20125E-02	2.72788E 00	2.79733E 00	2.88288E 00	5.50299E 01	2.33877E 00	-1.25706E-02	-2.13681E 00
-1.96952E-02	1.70794E-01	7.26260E-03	3.27050E 00	1.39986E-01	5.17831E-06	7.00921E-02	6.25697E-01
-4.06833E 00	-4.34055E 00	-8.56186E-01	2.32360E 00	6.28041E-02	-2.63142E-02	-2.28287E 00	-2.03148E 00
6.15520E 01	6.33783E 01	-6.39216E-01	5.52813E 01	2.40730E-03	9.54473E 01	-9.31340E-01	3.59889E 00
-7.22127E 01	-2.94331E 03	-3.01073E 03	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
FF							
-3.01621E 02	-7.20214E 02	-7.09325E 03	-4.09793E 02	-3.34045E 03	5.69582E 03	2.86329E 01	-2.09074E 02
-8.79624E 03	3.76886E 01	5.94226E 02	6.94819E 03				
FN							
-9.89533E 01	0.0	1.37702E 02	0.0	5.51309E 02	0 .		

TABLE 5-1 - Continued

CASE 2016.	MO-DA-YR			END OF TRIM DATA			
Y(I)							
-8.76505E-02	2.78701E-01	-9.29641E-02	0.0	0.0	0.0	0.0	0.0
-1.04009E-02	2.78701E-01	9.29641E-02	0.0	0.0	0.0	0.0	0.0
4.21393E-02	-2.17537E-02	0.0	0.0	1.22997E 02	8.99865E-04	-8.25526E-01	0.0
0.0	0.0	-2.08819E-02	-6.71033E-03	0.0	0.0		
YD(I)							
1.54545E-01	3.85449E-01	1.53962E 01	0.0	0.0	0.0	0.0	0.0
-1.59764E 00	3.85449E-01	-1.53962E 01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	3.39300E 01	-2.24523E 00	-1.29161E 01	1.43735E 00	-1.72708E 00
1.45078E-01	-2.06608E-01	0.0	0.0	0.0	0.0		
YDD(I)							
3.64945E 01	-1.33483E 02	1.11279E 02	0.0	0.0	0.0	0.0	0.0
-4.99727E 01	-1.33483E 02	-1.11279E 02	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	-2.46131E 00	-1.22437E 01	-3.07549E 01	-1.72708E 00
1.45078E-01	-2.06808E-01	0.0	0.0	0.0	0.0		
ZDD							
0.0	0.0	0.0	0.0				
0.0	0.0						
QFG(I)							
1.11636E 01	-9.40736E 00	-8.31578E 01	0.0	0.0	0.0	0.0	0.0
1.37999E 01	-9.40736E 00	6.31578E 01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	-3.50636E 02	-6.05555E 02	3.12569E 02	-1.56239E 02
-3.22009E 03	-1.45487E 03	1.55547E 01	-6.39230E 00	0.0	0.0		

TABLE 5-1 - Continued

HARMONIC ANALYSIS (TYPICAL SAMPLE)

HARMONICS	0	1	2	3	4	5	6
SHAFT LONGITUDINAL LOAD--LBS							
SIN COMPONENT	0.0	6.28985E 00	-6.19793E 02	-1.60436E 01	1.36041E 01	-3.25086E 00	-2.63271E 00
COS COMPONENT	2.12007E 01	3.16692E 00	-3.34460E 02	-3.47363E-01	-6.61800E 00	-1.38631E-02	4.82426E-01
PHASE ANGLE, FIRST MAXIMUM FROM $\psi_{BL1}=0$		6.32748E 01	1.20824E 02	8.95865E 01	2.89854E 01	5.39511E 01	4.67306E 01
AMPLITUDE		7.04213E 00	7.04277E 02	1.60474E 01	1.51284E 01	3.25089E 00	2.67655E 00
SHAFT LATERAL LOAD--LBS							
SIN COMPONENT	0.0	-5.04295E 00	3.29260E 02	3.61253E-01	6.07613E 00	1.17388E-01	-4.10324E-01
COS COMPONENT	-8.07045E 01	5.32512E 00	-6.36246E 02	-1.46081E 01	1.53713E 01	-2.03866E 00	-1.54335E 00
PHASE ANGLE		3.16559E 02	7.63191E 01	5.95278E 01	5.39212E 00	3.53409E 01	3.24814E 01
AMPLITUDE		7.33405E 00	7.16394E 02	1.46126E 01	1.65286E 01	2.04204E 00	1.59697E 00
SHAFT AXIAL LOAD-LBS							
SIN COMPONENT	0.0	6.89312E 00	2.51273E 02	9.93032E-01	-1.08044E 00	1.13313E 00	1.40822E 00
COS COMPONENT	-7.45081E 03	3.81569E 01	3.31667E 02	-8.01497E-01	-3.39740E 00	-1.77344E-01	2.66992E-01
PHASE ANGLE		1.02401E 01	1.85739E 01	4.29692E 01	4.94104E 01	1.97790E 01	1.32107E 01
AMPLITUDE		3.87745E 01	4.16102E 02	1.27613E 00	3.56506E 00	1.14692E 00	1.43331E 00
ROTOR ROLL MOMENT--IN-LBS							
SIN COMPONENT	0.0	-5.60406E 02	-1.60263E 04	6.79616E 01	-1.62568E 03	1.41000E 01	1.30489E 02
COS COMPONENT	-3.13565E 03	-7.26644E 01	3.00687E 03	-1.57238E 01	2.80023E 02	8.46562E 00	1.32292E 00
PHASE ANGLE		2.62612E 02	1.40313E 02	3.43423E 01	6.99433E 01	1.18039E 01	1.49032E 01
AMPLITUDE		5.65097E 02	1.63060E 04	6.97568E 01	1.64962E 03	1.64462E 01	1.30496E 02
ROTOR PITCH MOMENT--IN-LBS							
SIN COMPONENT	0.0	-1.20675E 02	-3.92221E 03	-6.16765E 01	-3.50563E 02	-6.02276E 01	-4.91098E 01
COS COMPONENT	-2.09256E 04	-4.08498E 02	-1.82969E 04	1.11482E 02	-1.26724E 03	4.08693E 01	2.07644E 02
PHASE ANGLE		1.96458E 02	9.60496E 01	1.10349E 02	4.88700E 01	6.08320E 01	5.77822E 01
AMPLITUDE		4.25949E 02	1.87125E 04	1.27406E 02	1.31494E 03	7.27851E 01	2.13373E 02
ROTOR TORQUE MOM--IN-LBS							
SIN COMPONENT	0.0	-3.43165E 02	3.26082E 04	-2.98726E 02	-1.48599E 02	-1.23336E 02	-9.47156E 01
COS COMPONENT	6.55051[illegible] 04	1.86968E 03	-1.94864E 04	-1.75237E 02	9.65288E 01	-4.04719E 01	-4.50073E 01
PHASE ANGLE		3.49599E 02	6.04311E 01	7.98678E 01	7.57519E 01	5.03666E 01	4.07640E 01
AMPLITUDE		1.90091E 03	3.79870E 04	3.46332E 02	1.77199E 02	1.29807E 02	1.04865E 02
BL-1 FEATHERING ANGLE--DEGS							
SIN COMPONENT	0.0	-2.41378E 00	7.52670E-03	2.41511E-04	2.40929E-04	1.59350E-04	1.28360E-04
COS COMPONENT	1.29610E 01	1.25071E 00	3.23028E-02	-1.57706E-04	-1.92340E-04	-8.86281E-05	-7.90278E-05
PHASE ANGLE		2.97391E 02	6.55808E 00	4.10481E 01	3.21503E 01	2.36164E 01	2.02699E 01
AMPLITUDE		2.71856E 00	3.31680E-02	2.88442E-04	3.08288E-04	1.82339E-04	1.50737E-04

TABLE 5-1 - Continued

HARMONIC ANALYSIS

	0	1	2	3	4	5	6
TWIST AT (25.6) —DEGS.							
SIN COMPONENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COS COMPONENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PHASE ANGLE		0.0	0.0	0.0	0.0	0.0	0.0
AMPLITUDE		0.0	0.0	0.0	0.0	0.0	0.0
TWIST AT (10.9) —DEGS.							
SIN COMPONENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COS COMPONENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PHASE ANGLE		0.0	0.0	0.0	0.0	0.0	0.0
AMPLITUDE		0.0	0.0	0.0	0.0	0.0	0.0
TWIST AT (14.5) —DEGS.							
SIN COMPONENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COS COMPONENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PHASE ANGLE		0.0	0.0	0.0	0.0	0.0	0.0
AMPLITUDE		0.0	0.0	0.0	0.0	0.0	0.0
BL-1 FEATHERING MOM.—IN-LBS							
SIN COMPONENT	0.0	3.79887E 02	-3.06705E 02	-3.89040E 01	5.22707E 00	-2.74174E-01	3.05673E 00
COS COMPONENT	9.50927E 03	-3.29667E 02	1.70345E 02	3.21358E 01	1.80228E 00	-2.02806E 00	2.33281E 00
PHASE ANGLE		1.30952E 02	1.49524E 02	1.03186E 02	1.77440E 01	3.75398E 01	8.77502E 00
AMPLITUDE		5.02985E 02	3.50835E 02	5.04602E 01	5.52906E 00	2.04651E 00	3.84521E 00
SWEEP AT .75 RADIUS--RAD							
SIN COMPONENT	0.0	9.48998E-04	-3.16822E-04	-7.24889E-07	2.81203E-06	1.90966E-06	1.56311E-06
COS COMPONENT	-1.53332E-03	-1.31161E-03	1.05423E-04	-4.15656E-06	-1.74006E-06	-1.05231E-06	-7.80309E-07
PHASE ANGLE		1.44113E 02	1.44203E 02	6.32976E 01	3.04372E 01	2.37713E 01	1.94214E 01
AMPLITUDE		1.61893E-03	3.33902E-04	4.21929E-06	3.30686E-06	2.18040E-06	1.74705E-06
DROOP AT .75 RADIUS--RAD							
SIN COMPONENT	0.0	-1.18353E-03	4.78493E-04	-1.62836E-05	-4.27365E-06	-2.64453E-06	-2.22227E-06
COS COMPONENT	5.94412E-04	1.66563E-03	-2.56639E-04	-1.20251E-05	3.71463E-06	1.52698E-06	1.10144E-06
PHASE ANGLE		3.24604E 02	5.91034E 01	7.78516E 01	7.77493E 01	6.00005E 01	4.93942E 01
AMPLITUDE		2.04330E-03	5.42972E-04	2.02425E-05	5.66238E-06	3.05372E-06	2.48026E-06
BL-1 TIP DISPLACE.—INCHES							
SIN COMPONENT	0.0	1.00623E 21	6.55344E 19	-7.68723E 19	-9.39586E 18	5.67769E 16	7.21079E 19
COS COMPONENT	-1.94260E 26	4.17204E 20	4.51023E 20	6.06590E 20	6.46558E 20	6.20118E 20	6.59778E 20
PHASE ANGLE		6.74801E 01	4.13366E 00	1.17592E 02	8.97919E 01	1.04915E-01	1.03953E 00
AMPLITUDE		1.08929E 21	4.55759E 20	6.11442E 20	6.46626E 20	6.20144E 20	6.63707E 20
SHAFT LONG. LOAD-AIR ONLY-LB							
SIN COMPONENT	0.0	2.23747E 00	-1.40469E 02	2.04726E 00	-2.32544E 00	9.05392E-01	5.42086E-01
COS COMPONENT	5.16702E 00	3.18980E 00	2.75329E 01	-5.69923E-01	4.15319E-01	-3.48900E-01	-2.66726E-01
PHASE ANGLE		3.50476E 01	1.40545E 02	3.51854E 01	7.00316E 01	2.22149E 01	1.93665E 01
AMPLITUDE		3.89630E 00	1.43142E 02	2.12511E 00	2.36224E 00	9.70291E-01	6.04153E-01

TABLE 5-1 - Continued

ADDITIONAL END OF TRIM DATA

FUSELAGE AIRLOADS IN WIND AXES

```
FNW(1) - FNW(6)
-1.09471E 02     0.0            1.29497E 02      0.0                      5.51304E 02     0.0
FREE STREAM α    FUS. LOCAL FLOW α   ANGLE OF SIDESLIP   FUS. LIFT COEFFICIENT
  ALFA             ALFAR            BETA             CL
-3.56154E-01    -4.50843E 00       0.0             -1.91093E-01

TRIMMING PROCESS IS COMPLETE
```

AIST / GLFIP / XCSI	BIST / GMFIP / YCSI	THCT / TGMIP / T	ANGC / ANGGM / SHP	LIP / CYTOFL / FGFZ	MIP / SMTOGM / TRUEC	SMIP / GM/SM	ANGSM / SM/CY
-1.24653E 00	8.82997E-05	1.24653E 00	-9.00107E 01	-4.91752E 03	-4.00853E 04	4.03857E 04	-1.73019E 02
4.97164E-02	-7.01849E 02	7.01849E 02	1.80009E 02	6.99191E 00	3.53026E 02	1.73786E-02	3.23985E 04
-2.84085E 00	-1.10145E 00	7.84763E 03	3.51380E 02	1.61242E 03	1.29461E 01		
0.0							

A1ST, B1ST	TRUE MAIN ROTOR CYCLIC ANGLES, DEG
THCT, ANGC	VECTOR MAGNITUDE AND PHASE FOR ABOVE
LIP, MIP	ROTOR ROLL AND PITCH SHAFT MOMENT IN STATIONARY AXES, IN-LB
SMIP, ANGSM	VECTOR MAGNITUDE AND PHASE FOR ABOVE
GLFIP, GMFIP	CONTROL GYRO FEEDBACK ROLL AND PITCH MOMENT, IN-LB
TGMIP, ANGGM	VECTOR MAGNITUDE AND PHASE FOR ABOVE
CYTOFL	PHASE (AZIMUTH) FLAP MAXIMUM LEADS MAXIMUM NOSE UP CYCLIC, DEG
SMTOGM	PHASE CONTROL GYRO FEEDBACK MOMENT LEADS MAXIMUM FLAP MOMENT, DEG
GM/SM	FEEDBACK CONTROL GYRO MOMENT TO ROTOR SHAFT MOMENT RATIO
SM/CY	SHAFT MOMENT TO CYCLIC ANGLE RATIO, IN-LB/DEG
XCSI, YCSI	LONGITUDINAL AND LATERAL TRIM STICK POSITION, IN
T	MAIN ROTOR LIFT, LB
SHP	MAIN ROTOR SHAFT HORSEPOWER
FGFZ	VERTICAL FORCE ON SWASHPLATE, LB
TRUEC	TRUE MAIN ROTOR COLLECTIVE, DEG

TABLE 5-1 - Continued

CASE 2016. MO-DA-YR

BEGINNING OF FLY DATA

TIME	SCY	XCS	YCS	US	VS	WS	PR
QR	RR	THETA	PSI	PHY	O	THFDD(1)	GZ
FP(1)	FP(4)	A1S	B1S	MINF8	MAXF8	MINF9	MAXF9
F(8,1)	F(9,1)	ZG	GX	GY	PRD	QRD	RRD
GL	GM	GFZ	FGF(1)	FGF(2)	WIMR	PIMR	QIMR
GLGH	GMGH	GLCON	GMCON	GLFEED	GMFEED	GK	GD
0.0	0.0	-2.36738E-01	-9.17879E-02	1.22998E 02	0.0	-7.64567E-01	0.0
0.0	0.0	-6.71033E-03	0.0	-2.08819E-02	3.39300E 01	-2.76470E 01	-3.08248E 01
0.0	0.0	-2.17537E-02	4.21393E-02	-7.38727E 02	-7.38727E 02	6.51836E 03	6.51836E 03
-7.38727E 02	6.51836E 03	0.0	-1.10240E 00	1.35183E 00	-1.83437E 00	1.05306E-01	-2.46431E-01
0.0	-5.55391E 01	-2.15736E 03	0.0	-5.55391E 01	1.05038E 01	5.39862E-03	-1.55255E-03
-4.21393E-02	2.17537E-02	-4.21393E-02	2.17537E-02	-1.61885E 25	-1.16976E 42	4.21393E-02	-2.17537E-02
LD							
-9.80307E 01	2.66981E 02	1.18152E 02	1.42995E 03	5.79927E 02	-7.15070E 03		
THF							
2.48562E-01	0.0	2.05055E-01	0.0				
TFA							
7.81240E 02	0.0	6.36779E 02	0.0				
F							
-3.54555E 02	-5.91355E 01	-1.88743E 03	-1.09564E 05	-1.36136E 03	-4.03954E 03	5.27529E 02	-7.38727E 02
6.51836E 03	3.80975E 02	-3.30363E 02	-4.30588E 03	2.93713E 02	-6.63699E 04	4.96376E 03	4.06319E 02
0.0	7.06602E 02	2.20402E 00	-2.21516E-01	-2.22552E-02	-2.89075E-02	2.33953E 00	2.78210E-02
-9.20091E-02	2.72788E 00	2.79743E 00	2.88288E 00	5.50298E 01	2.33876E 00	-1.25707E-02	-2.13681E 00
-1.96950E-02	1.70794E-01	7.26361E-03	3.27049E 00	1.39985E-01	5.17446E-06	7.00906E-02	6.25692E-01
-4.06933E 00	-4.34055E 00	-8.56186E-01	2.32357E 00	6.71676E-02	-2.18256E-02	-2.28303E 00	-2.03167E 00
6.15552E 01	6.33816E 01	-6.39097E-01	5.52842E 01	-1.50585E-03	9.54473E 01	-9.31341E-01	3.59889E 00
-7.23203E 01	-2.94509E 03	-3.01253E 03	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
FF							
-2.65375E 02	-4.27316E 02	-7.12236E 03	-3.09354E 02	-3.64910E 03	6.36020E 03	2.86753E 01	-2.09192E 02
-8.79684E 03	3.83759E 01	4.95750E 02	6.94924E 03				
FN							
-9.90067E 01	0.0	1.36998E 02	0.0	5.39645E 02	0.0		

TIME	ELAPSED TIME IN FLY	F(8,1), F(9,1)	BLADE 1 ROOT FLAP AND INPLANE MOMENTS
SCY	SINE OF AXIMUTH OF BLADE 1	ZG	SWASHPLATE DISPLACEMENT
XCS, YCS	LONGITUDINAL AND LATER STICK POSITIONS	GX, GY	LONGITUDINAL AND LATERAL INERTIAL ACCELERATIONS IN FUSELAGE AXES
US, VS, WS, PR, AR, RR	VELOCITIES OF FUSELAGE	PRD, QRD, RRD	ANGULAR ACCELERATIONS OF FUSELAGE
THETA, PSI, PHI	HUB EULER ANGLES IN EARTH AXES	GL, GM	SWASHPLATE ROLL AND PITCH MOMENT
O	ROTOR SPEED	GFZ	VERTICAL SWASHPLATE FORCE
THFDD(1)	FEATHERING ACCELERATION OF BLADE 1	FGF(1), FGF(2)	SWASHPLATE EXTERNAL ROLL AND PITCH MOMENT
GZ	FUSELAGE VERTICAL INERTIAL ACCELERATION IN FUSELAGE AXES	WIMR, PIMR, QIMR	VERTICAL ROLL AND PITCH DOWNWASH VELOCITIES AT MAIN ROTOR
FP(1), FP04		GLGH, GMGH	SWASHPLATE SPRING ROLL AND PITCH MOMENT
FP(1), FP(4)	PROPELLER THRUST AND TORQUE	GLCON, GMCON	SWASHPLATE CONTROL ROLL AND PITCH MOMENT
A1S, B1S	CYCLIC ANGLES AS DETERMINED BY SWASHPLATE TILT	GLFEED, GMFEED	CONTROL GYRO FEEDBACK ROLL AND PITCH MOMENT
MINF8, MAXF8	MINIMUM AND MAXIMUM BLADE 1 ROOT FLAP MOMENT	GK, GD	SWASHPLATE ROLL AND PITCH TILT
MINF9, MAXF9	MINIMUM AND MAXIMUM BLADE 1 ROOT INPLANE MOMENT	(REMAINING DATA)	SEE TRIM TABULATION FOR DESCRIPTIVE MATERIAL

TABLE 5-1 - Continued

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CASE    2016.          MO-DA-YR
Y(I)
-8.76505E-02    2.78701E-01   -9.29641E-02    0.0            0.0            0.0            0.0            0.0
-1.04009E-02    2.78701E-01    9.29641E-02    0.0            0.0            0.0            0.0            0.0
 4.21393E-02   -2.17537E-02    0.0            0.0            1.22997E 02    8.99865E-04   -8.25526E-01    0.0
 0.0            0.0           -2.08819E-02   -6.71033E-03    0.0            0.0
YD(I)
 1.54545E-01    3.85449E-01    1.53962E 01    0.0            0.0            0.0            0.0            0.0
-1.59764E 00    3.85449E-01   -1.53962E 01    0.0            0.0            0.0            0.0            0.0
 0.0            0.0            0.0            3.39300E 01   -1.22279E 01   -2.81217E 01    1.45920E 00   -4.51084E 00
 1.99492E 00   -9.60375E-02    0.0            0.0            0.0            0.0
YDD(I)
 7.65990E 01   -1.35265E 02    6.82827E 01    0.0            0.0            0.0            0.0            0.0
-9.66780E 01   -1.35265E 02   -6.82827E 01    0.0            0.0            0.0            0.0            0.0
 0.0            0.0            0.0            0.0           -1.24439E 01   -2.74494E 01   -3.07330E 01   -4.51084E 00
 1.99492E 00   -9.60375E-02   -4.48820E 00    1.99773E 00    0.0            0.0
ZDD
 0.0            0.0            0.0            0.0
 0.0            0.0
ZD
 0.0            0.0            0.0            0.0
 0.0            0.0
Z
 0.0            0.0           -1.17696E-03   -4.95619E-04
 0.0            0.0
QFG(I)
 4.77510E 01   -1.57835E 01   -8.98923E 01    0.0            0.0            0.0            0.0            0.0
-4.48526E 01   -1.57835E 01    8.98923E 01    0.0            0.0            0.0            0.0            0.0
 0.0            0.0            0.0            0.0           -7.64254E 01    1.16197E 02   -2.65896E 01    1.51789E 02
-3.93010E 03    3.03379E 02   -2.10842E 03    1.78694E 03    0.0            0.0
-1.00000E 00   -1.00000E 00

MANEUVER HAS BEEN COMPLETED. GO TO NEXT CASE
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TABLE 5-1 - Continued

END OF FLY DATA

CASE 2016. MO-DA-YR

TIME	SCY	XCS	YCS	US	VS	WS	PR
QR	RR	THETA	PSI	PHI	O	THFDD(1)	GZ
FP(1)	FP(4)	AIS	BI.	MINF8	MAXF8	MINF9	MAXF9
F(8,1)	F(9,1)	ZG	GX	GY	PRD	QRD	RRD
GL	GM	GFZ	FGF(1)	FGF(2)	WIMR	PIMR	QIMR
GLGH	GMGH	GLCON	GMCON	GLFFED	GMFEED	GK	GD
5.00016E 00	6.17211E-02	-1.94738E-01	-2.17879E-02	1.06391E 02	1.42654E 01	1.09726E 01	-1.05249E-02
9.41994E-02	6.36663E-03	2.55398E-01	-1.29356E-02	9.94631E-02	3.39300E 01	-2.42274E 01	-3.80648E 01
0.0	0.0	-2.17537E-02	3.46633E-02	-7.38727E 02	2.90252E 03	-1.32241E 03	7.32496E 03
-2.86352E 02	4.83702E 03	0.0	5.80711E-01	-8.96556E-01	4.29862E-01	-2.90594E-02	-1.03460E-01
1.49684E 00	2.42055E 01	-2.21396E 03	1.49684E 00	2.42055E 01	1.45567E 01	9.15267E-02	-1.17540E-02
-3.46633E-02	2.17537E-02	-3.46637E-02	2.17537E-02	-1.61885E 25	-1.16975E 42	3.46633E-02	-2.17537E-02
LD							
-3.87897E 01	-7.59124E 01	7.22940E 01	8.21213E 02	4.54816E 02	-4.38753E 03		
THF							
2.43095E-01	0.0	2.03949E-01	0.0				
TFA							
8.42360E 02	0.0	6.18108E 02	0.0				
F							
-2.63445E 02	-2.60640E 01	-1.85937E 03	-1.09199E 05	-1.14431E 03	-4.80949E 03	6.21260E 02	-2.86352E 02
4.83702E 03	4.95453E 02	-3.27818E 02	-5.17633E 03	2.58299E 02	-7.83349E 04	4.94888E 03	4.32392E 02
0.0	7.35452E 02	2.20886E 00	-2.13302E-01	-5.90636E-02	-6.69664E-02	2.31716E 00	3.56929E-02
-8.16619E-02	2.72893E 00	2.79831E 00	2.88363E 00	5.47379E 01	2.29978E 00	-1.28063E-02	-1.93258E 00
-2.58766E-02	1.99317E-01	3.74266E-02	3.25484E 00	1.37883E-01	7.25931E-05	7.72822E-02	6.12878E-01
-4.06801E 00	-4.34054E 00	-5.09258E-01	2.58376E 00	3.93413E 00	3.94407E 00	-2.38134E 00	-1.97462E 00
6.14427E 01	6.32668E 01	-1.32807E 00	6.49621E 01	-4.04461E 00	9.54194E 01	-8.62146E-01	4.26449E 00
-3.71540E 01	-3.46840E 03	-3.55588E 03	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
FF							
4.08997E 01	-1.70982E 02	-6.69083E 03	-3.14680E 02	-1.66617E 03	4.41347E 03	4.63064E 01	-3.01331E 02
-1.01378E 04	-2.63536E 02	-3.48751E 03	5.67169E 03				
FN							
-3.72064E 01	-2.76555E 02	6.38258E 01	-5.75807E 01	4.26168E 02	-3.92243E 01		

TABLE 5-1 - Continued

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CASE    2016.          MO-DA-YR
Y(I)
-5.94101E-02   1.14708E-01   -8.81603E-02   0.0            0.0            0.0            0.0            0.0
-1.54131E-02   1.14708E-01    8.81603E-02   0.0            0.0            0.0            0.0            0.0
 3.46633E-02  -2.17537E-02    0.0           1.69708E 02    1.05926E 02    1.39649E 01    1.08822E 01   -4.49916E-02
 5.17431E-02   6.42764E-03    9.94631E-02   2.55398E-01   -1.29356E-02    0.0
YD(I)
-3.21847E-01   1.71326E-01    1.63594E 01   0.0            0.0            0.0            0.0            0.0
-1.50403E 00   1.71326E-01   -1.63594E 01   0.0            0.0            0.0            0.0            0.0
 0.0           0.0            0.0           3.39300E 01   -1.99084E 01   -1.69994E 01   -8.84415E-01   -2.98743E 00
 1.90759E 00  -6.78133E-02   -4.19801E-02   5.08491E-02    1.19208E-02    0.0
YDD(I)
 9.82362E 00  -8.54571E 01    1.08380E 02   0.0            0.0            0.0            0.0            0.0
-3.67520E 01  -8.54571E 01   -1.08380E 02   0.0            0.0            0.0            0.0            0.0
 0.0           0.0            0.0           0.0           -1.13004E 01   -1.89226E 01   -3.79952E 01   -2.98743E 00
 1.90759E 00  -6.78133E-02   -3.39235E 00   1.94123E 00    0.0            0.0
ZDD
 0.0           0.0           -3.55070E 00   1.74267E 00
 0.0           0.0
ZD
 0.0           0.0           -3.44724E-02  -4.24549E-02
 0.0           0.0
Z
 0.0           0.0           -2.29161E-04  -6.80353E-04
 0.0           0.0
QFG(I)
 1.00634E 01  -2.22529E 00   -4.19197E 01   0.0            0.0            0.0            0.0            0.0
 6.87098E 00  -2.22529E 00    4.19197E 01   0.0            0.0            0.0            0.0            0.0
 0.0           0.0            0.0           0.0           -3.41561E 01    1.32650E 01   -5.03589E 00   -1.05299E 02
-1.83268E 03  -1.15914E 02    4.26142E 01   3.54238E 01    0.0            0.0
-1.00000E 00  -1.00000E 00

MO-DA-YR

END OF RUN
```

6. COMPUTER INSTALLATION REQUIREMENTS

REXOR is written entirely in FORTRAN IV and has been developed on an IBM 360/91 computer. Hardware dependency is restricted to only a few major software areas:

1. Fortran initialization of literal data is word size dependent.

2. Graphic output software is Calcomp dependent.

Software incompatibilities are restricted to:

1. Character string definition techniques.

2. Overlay features.

REXOR will run on any IBM 360 or 370 model which is large enough to support IBM's FORTRAN IV H-level compiler. One routine in REXOR, namely SWEEP1, requires 520 k bytes of core to compile. This is the pacing item on IBM core requirements. Besides the normal FORTRAN input, output, and punch output devices, REXOR utilizes three auxilliary storage I/O units. The I/O operations are sequential; thus, the actual device type is not important. All installation dependent software has been removed to enhance portability, except as mentioned above, in the area of graphic output.

Besides its parent installation, REXOR has been installed at two other computer installations as of this writing. One is the Midwest S&E computer at the U. S. Army Aviation Systems Command. This is an IBM 360/65. The other installation is the Langley Research Center computer complex which includes CDC 6000 series computers and software. Specifics concerning the program as installed on IBM and CDC hardware, and in particular the installations mentioned, will be presented below.

6.1 IBM 360/370 SERIES HARDWARE

REXOR requires a minimum of 520 k bytes of core for compilation. This requirement is due to subroutine SWEEP1. If SWEEP1 is compiled separately, the compilation core requirement is substantially reduced. The core requirement during execution is approximately 375 k bytes when the overlay option of the LINKAGE EDITOR program is invoked. A general schematic of the IBM overlay structure is presented in Figure 6-1. The program was somewhat arbitrarily divided into the classic INPUT-PROCESS-OUTPUT categories. The current structure is not minimal in design.

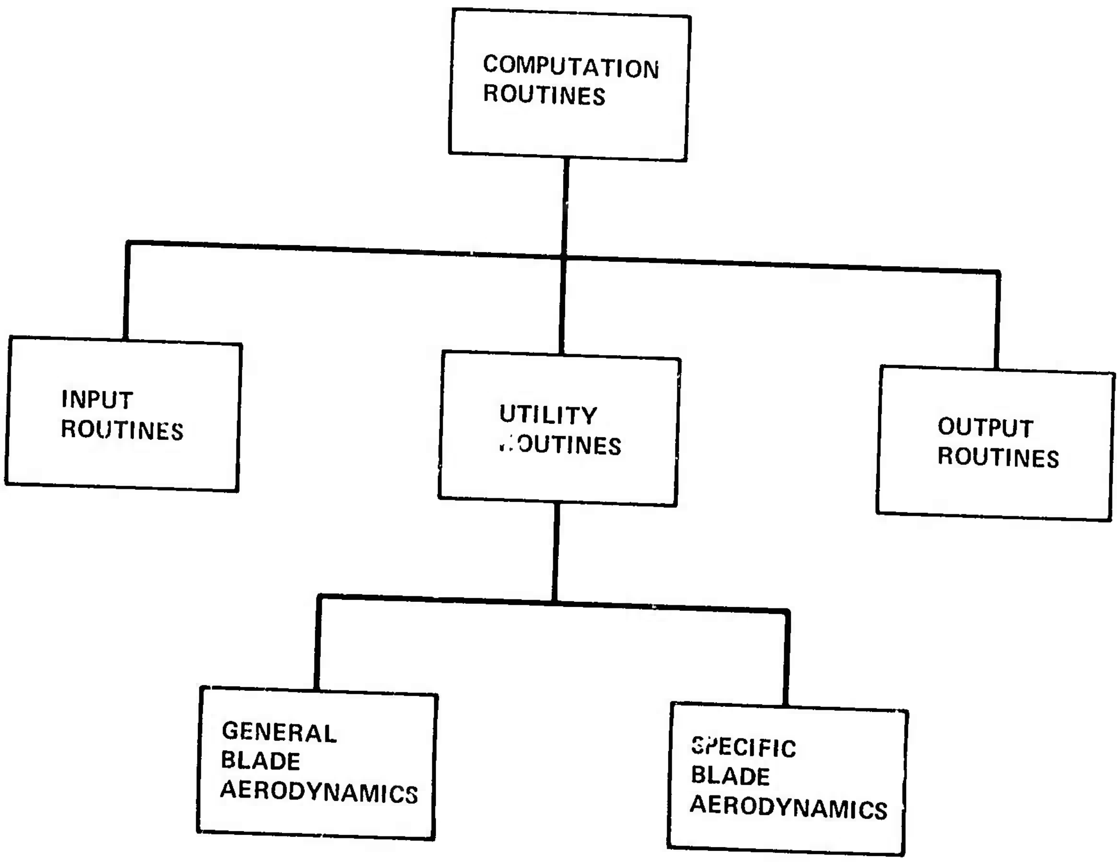

Figure 6-1. IBM Overlay Structure.

The program logical I/O unit numbers and usage are indicated in the following Table 6-1.

TABLE 6-1. I/O UNITS

Unit #	Usage
3	Scratch Data Set
5	Normal Fortran Input Data Set
6	Normal Fortran Output Data Set
7	Punch Card Output Data Set
8	Scratch Data Set
12	Scratch Data Set

The device requirements for the scratch units 3, 8, and 12 are direct access or magnetic tape. Typical DCB parameters are:

UNIT 3	-	RECFM=FB, LRECL=80, BLKSIZE=800
8	-	RECFM=VSB, BLKSIZE=2008
12	-	RECFM=VSB, BLKSIZE=2524

The space parameter of the data definition control statement is a function of the actual device used. The following normal working limits should be allocated. However, these numbers are not absolute.

UNIT 3	-	80 k bytes
8	-	124 k bytes
12	-	124 k bytes

6.2 CDC 6000 SERIES HARDWARE

REXOR has been installed on CDC hardware at LRC, Langley Research Center. Software requirements in the area of literal definitions and overlay capabilities are significantly different from IBM. Therefore, a separate CDC compatible version must be maintained.

The complete source program is stored at the LRC computer center on a data cell. CDC 6600 core requirement for compilation is approximately 102200 octal words. The field length for the execution phase is approximately 250,000 octal words. CDC 6600 compilation time for the complete program has been measured at approximately 200 seconds. The program auxiliary storage device requirements are the same as described in Section 6.1. Beyond the actual definition of the units, the program accepts default system definitions.

The CDC overlay structure is conceptually similar to the IBM version; however, the physical implementation is quite different. The CDC overlay program structure can be seen in Figure 6-2.

The BAERO program computes general blade aerodynamic coefficients. The FBAERO program computes blade aerodynamics and stall based on a specialized blade data set.

6.3 GRAPHIC HARDWARE/SOFTWARE REQUIREMENTS

Graphic output capability is highly installation dependent. Even though the three installations at which REXOR has been installed all use CALCOMP drum plotters, the driving software is somewhat different. The three installations are characterized in Table 6-2.

TABLE 6-2. CALCOMP OPERATION

Facility	Hardware Identification	Software
Calac	CALCOMP 765 12-inch drum	CALAC enhanced CALCOMP software
Langley	CALCOMP 765 12-inch drum	LRC Graphic Output System
St. Louis	CALCOMP 536 30-inch drum	CALCOMP supplied software

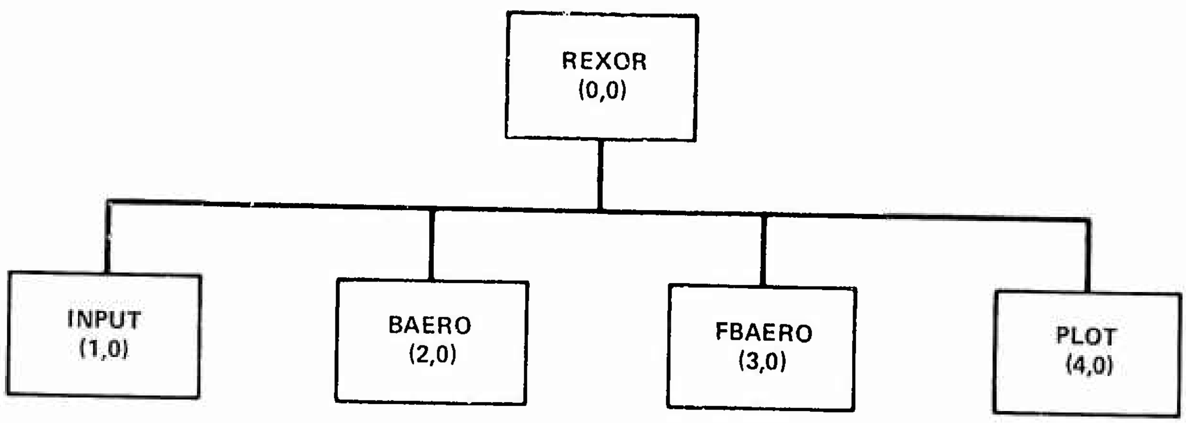

Figure 6-2. CDC Overlay Schematic

LIST OF SYMBOLS

SYMBOLS

a	arbitrary vector
$\ddot{a}_0$	acceleration vector, ft/sec^2
a_1	longitudinal component of blade first harmonic flapping, rad
$[A]$	generalized mass element matrix
$A_{1,2,3}$	modal variables
A_{1n}	generalized displacement of nth blade, first mode
A_{2n}	generalized displacement of nth blade, second mode
A_{3n}	generalized displacement of nth blade, third mode
A_{1S}	cosine component of blade first harmonic cyclic, rad
b	number of main rotor blades; arbitrary vector
B	dissipation function
B_{1S}	sine component of blade first harmonic cyclic, rad
c	blade segment chord, ft
$[C]$	damping matrix
C_D	aerodynamic drag coefficient
C_L	aerodynamic lift coefficient
C_M	aerodynamic pitching moment coefficient
C_P	power coefficient
C_T	thrust coefficient

$C_{X,Y,Z}$	linear damping, lb/ft/sec
$C_{\phi,\theta,\psi}$	rotary damping, ft-lb/rad/sec
$C_{1,2,3}$	blade bending to feathering couplings
$C(k)$	lift deficiency function
d	infinitesimal increment
dr	increment in rotor, radius, ft
dt	increment in time, sec
d/dt	derivative with respect to time
$(d/e)_0$	swashplate to feather gear ratio, zero collective
$(d/e)_1$	swashplate to feather gear ratio slope with collective
e	pitch horn effective crank arm, ft
EI	blade bending stiffness distribution, lb-ft^2
f_{iMR}	ground effect factor for main rotor
F	factor; force, lb
$F_{X,Y,Z}$	force components along X,Y,Z directions, lb
$F_{\phi,\theta,\psi}$	generalized force about ϕ, θ, ψ axis
$F_{\beta PH}$	feathering mode generalized force
g	gravity, ft/sec^2
$g_{X,Y,Z}$	gravity components along X,Y,Z directions
G	gear ratio
$\{G\}$	generalized force vector
$\ddot{G}$	gyro angular acceleration partial product
GJ	blade torsional stiffness, lb-ft^2
I_X	$= \Sigma m_i X_i^2$, slug-ft^2
I_Y	$= \Sigma m_i Y_i^2$, slug-ft^2

I_Z	$= \Sigma m_i Z_i^2$, slug-ft^2
I_{XX}	$= \Sigma m_i (Y_i^2 + Z_i^2)$, slug-ft^2
I_{YY}	$= \Sigma m_i (X_i^2 + Z_i^2)$, slug-ft^2
I_{ZZ}	$= \Sigma m_i (X_i^2 + Y_i^2)$, slug-ft^2
I_{XY}	$= \Sigma m_i X_i Y_i$, slug-ft^2
I_{XZ}	$= \Sigma m_i X_i Z_i$, slug-ft^2
I_{YZ}	$= \Sigma m_i Y_i Z_i$, slug-ft^2
i	unit vector
j	unit vector
J	advance ratio
k	number of blade radial stations; reduced frequency, rad/sec; unit vector
$[K]$	spring matrix
K_{mj}	blade spring matrix element
$K_{X,Y,Z}$	spring constants along X,Y,Z direction, lb/ft
$K_{\phi,\theta,\psi}$	spring rates about ϕ, θ, ψ axis, ft-lb/rad
l_{IB}	location inboard feather bearing, ft
l_{OB}	location outboard feather bearing, ft
l_p	radial location of intersection of precone and feather axis, ft
l_{TTI}	tension torsion pack length, ft
L	rolling moment, ft-lb
m	mass of element, slugs
m_F	summed fuselage coordinate mass, slugs
m_H	summed hub axis mass, slugs
m_i	mass of ith particle or blade segment, slugs

m_{SP}	swashplate summed mass, slugs
M	pitching moment, ft-lb; $= \Sigma m_i$, slugs
$[M]$	generalized mass matrix
M_{rk}	generalized mass matrix element
$M_{\bar{X}}$	$= \Sigma m_i X_i$, slug-ft
$M_{\bar{Y}}$	$= \Sigma m_i Y_i$, slug-ft
$M_{\bar{Z}}$	$= \Sigma m_i Z_i$, slug-ft
$M_{X,Y,Z}$	moments about X,Y,Z axis, ft-lb
M_{ϕ}	blade torsional moment, ft-lb/ft
N	number of system particles
p	angular velocity about X axis, rad/sec; particle
p_{iMR}	main rotor pitch moment inflow, ft/sec
q	generalized coordinate; angular velocity about Y axis, rad/sec
q_{iMR}	main rotor roll moment inflow, ft/sec
Q	generalized forcing function
Q_A	aerodynamic pressure times reference wing area, lb
QLOADS	total nonmain rotor aerodynamic loads matrix
Q_{TR}	tail rotor torque, ft-lb
r	general vector; radius of curvature, ft; angular velocity about Z axis, rad/sec; notation for (X,Y,Z)
r_S	static blade shape
R	vector displacement of particle p in X,Y,Z axis system
R_0	vector displacement of x,y,z origin in X,Y,Z system
$R_{Z\phi,Z\theta}$	gyro damper coupling ratios

S	Laplace variable, path of motion of particle p
S_{NA}	blade spline length along neutral axis locii, ft
t	time
T	kinetic energy, ft-lb
$[T]$	transformation of coordinates matrix
T_{TT}	tension in tension - torsion pack, lb
u	velocity in X direction, ft/sec
U	potential energy function, ft-lb; strain energy, ft-lb
$U_{C,P,S,T}$	air velocity on blade element, ft/sec
v	velocity in Y direction, ft/sec
V_T	trajectory velocity
w	velocity in Z direction, ft/sec
w_{iMR}	main rotor collective inflow, ft/sec
w_{iTR}	tail rotor collective inflow, ft/sec
x	motion in X direction, ft; blade span location
X	coordinate direction; axis; deflection, ft; location, ft; cross product
X_{SW}	blade radial station of sweep and jog, ft
X_T	trajectory path, ft
X_{TR}	tail rotor longitudinal force, lb
y	motion in Y direction, ft
Y	coordinate direction; axis; deflection, ft; location, ft
$Y_{TTO_{1,2,3}}$	tension torsion pack outboard end modal coefficients
Y_{ONA}	difference between Y direction locations of cg and neutral axis points of blade element, ft

z	motion in Z direction
Z	coordinate direction; axis; deflection, ft; location, ft
Z_{SP}	relative swashplate vertical displacement with respect to the hub, ft
$Z_{TTO_{1,2,3}}$	tension-torsion pack outboard end modal coefficients
Z_{OBL}	teetering rotor undersling, ft
Z_{OF}	hub set distance above fuselage set, ft
Z_{OSP}	hub set distance above swashplate set, ft
Z_{OTTI}	blade vertical offset at outboard end of tension - torsion pack, ft
α	angle of attack, rad
α_2	angle of attack with hub set, rad
β	sideslip angle, rad
β_{FA}	blade feathering angle, rad
β_{PHn}	feathering/pitch-horn bending or dynamic torsion generalized coordinate displacement
β_0	blade droop relative to precone angle, rad
γ	blade sweep angle, rad; dynamic stall delay, sec
γ_T	trajectory path angle with E set, rad
δ	limit deflection, rad; freeplay, rad; small increment
δ_{3TR}	tail rotor pitch - flap coupling
$\partial\varepsilon/\partial\alpha$	downwash factor of wing on horizontal tail
ζ	vector rotation of ϕ, θ, ψ
θ	rotation about Y axis, rad
θ_0	collective blade angle, rad
Λ	sideslip at blade element, rad
ρ	air density, slugs/ft^3

τ	time constant, sec; natural period, sec
τ_0	feathering axis precone, rad
ϕ	rotation about X axis, rad
ϕ_F	feathering angle, rad
ϕ_{Fn}	feathering angle of blade element of nth blade, rad
ϕ_{REF}	blade root reference feather angle, rad
ϕ_T	blade torsion, rad
Φ_T	sum of blade twist and torsion, rad
χ_{iMR}	wake angle of main rotor, deg
ψ	rotation about Z axis, rad; sideslip angle with hub set, rad
ψ_c	control input axis rotation from swashplate, rad
ψ_{PH}	pitch lead angle, deg
ψ_T	trajectory path yaw with E set, rad
ψ_W	main rotor apparent airflow angle, rad
ω	rotational speed, rad/sec; angular velocity, rad/sec; natural frequency, rad/sec
∂	partial derivative, derivation

SUBSCRIPTS

a	arbitrary coordinate set a
A	due to aerodynamics
b	arbitrary coordinate set b
BEND	associated with blade elastic bending
BLE	blade element coordinate system
BLn	blade reference axis system for the nth blade

C	associated with pilot control input, chordwise
CG	associated with center of gravity location
CORR	corrective, correction
DW	referring to downwash
DYN	referring to dynamic component
E	earth axis
ENG	associated with powerplant - engine
EST	estimated
F	fuselage axis; associated with blade feathering
FA	referring to blade feather axis
FB	associated with feedback
Fn	associated with feathering of the nth blade
FR	due to friction
G	referring to gyro or gyro coordinate system
GEN	associated with gas generator section of powerplant
GFB	associated with gyro control feedback
GSP	gyro to swashplate connection
GUB	relating to gyro gimbal unbalance
H	referring to hub or principal reference axis system
HT	associated with horizontal tail
i	referring to inflow, particle
IB	referring to inboard feather bearing location
j	spring matrix index
jog	associated with blade attachment joggle
J	associated with gyro end of feedback rod linkage

Jn	associated with feedback rod coming from the nth blade
k	generalized mass index
LAG	associated with lead-lag damper
LIMIT	signifying limiting value
m	blade mode index, spring matrix index
MR	associated with main rotor
n	blade number index; time point index
NA	referring to blade segment neutral axis
NEW	newly determined value
NO	normal (to airflow) component
NR	pertaining to nonrotating value
OB	referring to outboard feather bearing location
OLD	value from previous time step
P	associated with propeller; perpendicular blade component
PH	referring to pitch horn
r	generalized mass index
R	referring to rotor axis system
REF	associated with blade feather reference value
RM	referring to control gyro feedback lever moment
S	referring to blade spanwise velocity; general mode; static; structural; shaft
SC	referring to blade segment shear center
SP	referring to swashplate
SP_c	command to swashplate
S, SP	referring to swashplate limit stop

STEADY	steady component
SW	referring to blade sweep angle location
T	associated with trajectory path relating to E axis; tangential blade component; blade torsion; blade twist
TR	associated with the tail rotor
TRIM	initial or trim value
TT	associated with tension torsion pack
TTI	referring to inboard end of tension torsion pack
TTO	referring to outboard end of tension torsion pack
TW	associated with blade twist (built in)
UB	relating to control gyro unbalance
UNSTEADY	associated with unsteady component
VT	associated with vertical tail
WING	associated with the wing
X	relating to component in X direction
Y	relating to component in Y direction
YA	relating to aerodynamic component in Y direction
Z	relating to component in Z direction
ZA	relating to aerodynamic component in Y direction
0	(nought) associated with collective value, coordinate axis value, with respect to principal reference axis, blade root summation
1,2,3	with respect to blade modes 1, 2, or 3
1S	first harmonic component shaft axis feathering
1/4 c	with respect to blade 1/4 chord
3/4 c	with respect to blade 3/4 chord

β_{PHn}	associated with the feathering mode of the nth blade
ϕ	relating to component in the ϕ direction
θ	relating to component in the θ direction
ψ	relating to component in the ψ direction

SUPERSCRIPTS

I	referring to inertial reference
T	matrix transpose
$(\bar{\ })$	(bar) average quantity
$(')$	(prime) slope with respect to blade span
$(\dot{\ })$	(dot) time derivative of basic quantity
$(\ddot{\ })$	(double dot) second time derivative
(-1)	matrix inverse
$(\vec{\ })$	vector quantity

POSTSCRIPTS

(i)	blade radial station index
(n)	blade number index

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